



## Important Requirements of the International Residential Code

### Mandatory International Residential Building Requirements

All construction shall be in conformance with the International Residential Code (IRC) and International Energy Conservation Code (IECC), 2009 edition, as amended by Montgomery County Executive Regulation No. 26-09. All chapters, tables, sections, figures and appendices referenced herein are from the IRC and the IECC as amended. **This document addresses many frequently asked code questions and is provided for your convenience.** It is not intended as a substitute for the code or any of its provisions.

### A. Climatic and Geographic Design Parameters

*Ground Snow Load: 30psf  
Wind Speed: 90mph  
Seismic Design Category: B  
Weathering: Severe  
Frost Line Depth: 24 inches (minimum)  
Termite: Moderate to Heavy  
Winter Design Temperature: 13 °F  
Ice Shield Underlayment Required: Yes  
Flood Hazard: July 2, 1979  
Air Freezing Index: 300  
Mean Annual Temperature: 55 °F*

**\*It is unlawful to occupy or use any project for which a permit was issued without first receiving final inspection approval from this department.**

- 1) R302.1. Construction, projections, openings and penetrations of exterior walls of dwellings and accessory buildings shall comply with Table R302.1.

**Exceptions:**

1. Walls, projections, openings or penetrations in walls perpendicular to the line used to determine the fire separation distance.
2. Walls of dwellings and accessory structures located on the same lot.
3. Detached tool sheds and storage sheds, playhouses and similar structures exempted from permits are not required to provide wall protection based on location on the lot. Projections beyond the exterior wall shall not extend over the lot line.
4. Detached garages accessory to a dwelling located within 2 feet of a lot line are permitted to have roof eave projections not exceeding 4 inches.
5. Foundation vents installed in compliance with this code are permitted.

**Exception:** A common 1-hour fire-resistance-rated wall assembly tested in accordance with ASTM E 119 or UL 263 is permitted for townhouses if such walls do not contain plumbing or mechanical equipment, ducts or vents in the cavity of the common wall. The wall shall be rated for fire exposure from both sides and shall extend to and be tight against exterior walls and the underside of the roof sheathing. Electrical installations shall be installed in accordance with Chapters 34 through 43. Penetrations of electrical outlet boxes shall be in accordance with Section R302.4.

- 2) R302.2.1. The fire-resistance-rated wall or assembly separating townhouses shall be continuous from the foundation to the underside of the roof sheathing, deck or slab. The fire-resistance rating shall extend the full length of the wall or assembly, including wall extensions through and separating attached enclosed accessory structures.
- 3) R302.2.4. Each individual townhouse shall be structurally independent.  
**Exceptions:**
1. Foundations supporting exterior walls or common walls.
  2. Structural roof and wall sheathing from each unit may fasten to the common wall framing.
  3. Nonstructural wall and roof coverings.
  4. Flashing at termination of roof covering over common wall.
  5. Townhouses separated by a common 1-hour fire-resistance-rated wall as provided in Section R302.2.
- 4) R302.3. Dwelling units in two-family dwellings shall be separated from each other by wall and/or floor assemblies having not less than a 1-hour fire-resistance rating when tested in accordance with ASTM E 119 or UL 263. Fire-resistance-rated floor-ceiling and wall assemblies shall extend to and be tight against the exterior wall, and wall assemblies shall extend from the foundation to the underside of the roof sheathing.  
**Exceptions:**
1. A fire-resistance rating of  $\frac{1}{2}$  hour shall be permitted in buildings equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13.
  2. Wall assemblies need not extend through attic spaces when the ceiling is protected by not less than  $\frac{5}{8}$ -inch Type X gypsum board and an attic draft stop constructed as specified in Section R302.12.1 is provided above and along the wall assembly separating the dwellings. The structural framing supporting the ceiling shall also be protected by not less than  $\frac{1}{2}$ -inch gypsum board or equivalent.
- 5) R302.3.1. When floor assemblies are required to be fire-resistance rated by Section R302.3, the supporting construction of such assemblies shall have an equal or greater fire-resistance rating.
- 6) R302.4.1. Through penetrations of fire-resistance-rated wall or floor assemblies shall comply with Section R302.4.1.1 or R302.4.1.2.  
**Exception:** Where the penetrating items are steel, ferrous or copper pipes, tubes or conduits, the annular space shall be protected as follows:
1. In concrete or masonry wall or floor assemblies, concrete, grout or mortar shall be permitted where installed to the full thickness of the wall or floor assembly or the thickness required to maintain the fire-resistance rating, provided:
    - 1.1. The nominal diameter of the penetrating item is a maximum of 6 inches; and
    - 1.2. The area of the opening through the wall does not exceed 144 square inches.
  2. The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 or UL 263 time temperature fire conditions under a minimum positive pressure differential of 0.01 inch of water (3 Pa) at the location of the penetration for the time period equivalent to the fire resistance rating of the construction penetrated.
- 7) R302.4.1.2. Penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (3 Pa) and shall have an F rating of not less than the required fire-resistance rating of the wall or floor/ceiling assembly penetrated.
- 8) R302.4.2. Membrane penetrations shall comply with Section R302.4.1. Where walls are required to have a fire-resistance rating, recessed fixtures shall be installed so that the required fire-resistance rating will not be reduced.  
**Exceptions:**
1. Membrane penetrations of maximum 2-hour fire-resistance-rated walls and partitions by steel electrical boxes that do not exceed 16 square inches in area provided the aggregate area of the openings through the membrane does not exceed 100 square inches in any 100 square feet of wall area. The annular space between the wall membrane and the box shall not exceed  $\frac{1}{8}$  inch. Such boxes on opposite sides of the wall shall be separated by one of the following:

- 1.1. By a horizontal distance of not less than 24 inches where the wall or partition is constructed with individual non-communicating stud cavities;
  - 1.2. By a horizontal distance of not less than the depth of the wall cavity when the wall cavity is filled with cellulose loose-fill, rockwool or slag mineral wool insulation;
  - 1.3. By solid fire blocking in accordance with Section R302.11;
  - 1.4. By protecting both boxes with listed putty pads; or
  - 1.5. By other listed materials and methods.
  2. Membrane penetrations by listed electrical boxes of any materials provided the boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. The annular space between the wall membrane and the box shall not exceed  $\frac{1}{8}$  inch unless listed otherwise. Such boxes on opposite sides of the wall shall be separated by one of the following:
    - 2.1. By the horizontal distance specified in the listing of the electrical boxes;
    - 2.2. By solid fireblocking in accordance with Section R302.11;
    - 2.3. By protecting both boxes with listed putty pads; or
    - 2.4. By other listed materials and methods.
  3. The annular space created by the penetration of a fire sprinkler provided it is covered by a metal escutcheon plate.
- 9) R302.5.1. Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Other openings between the garage and residence shall be equipped with solid wood doors not less than  $1\frac{3}{8}$  inches in thickness, solid or honeycomb core steel doors not less than  $1\frac{3}{8}$  inches thick, or 20-minute fire-rated doors.
- 10) R302.5.2. Ducts in the garage and ducts penetrating the walls or ceilings separating the dwelling from the garage shall be constructed of a minimum No. 26 gage sheet steel or other approved material and shall have no openings into the garage.
- 11) R302.6. The garage shall be separated as required by Table R302.6. Openings in garage walls shall comply with Section R302.5. This provision does not apply to garage walls that are perpendicular to the adjacent dwelling unit wall.

TABLE R302.6  
DWELLING/GARAGE SEPARATION

SEPARATION	MATERIAL
From the residence and attics	Not less than $\frac{1}{2}$ -inch gypsum board or equivalent applied to the garage side
From all habitable rooms above the garage	Not less than $\frac{5}{8}$ -inch Type X gypsum board or equivalent
Structure(s) supporting floor/ceiling assemblies used for separation required by this section	Not less than $\frac{1}{2}$ -inch gypsum board or equivalent
Garages located less than 3 feet from a dwelling unit on the same lot	Not less than $\frac{1}{2}$ -inch gypsum board or equivalent applied to the interior side of exterior walls that are within this area

- 12) R302.7. Enclosed accessible space under stairs shall have walls, under-stair surface and any soffits protected on the enclosed side with  $\frac{1}{2}$ -inch gypsum board.

- 13) R302.10.1. Insulation materials, including facings, such as vapor retarders and vapor-permeable membranes installed within floor-ceiling assemblies, roof-ceiling assemblies, wall assemblies, crawl spaces and attics shall have a flame spread index not to exceed 25 with an accompanying smoke-developed index not to exceed 450 when tested in accordance with ASTM E 84 or UL 723.
- Exceptions:**
1. When such materials are installed in concealed spaces, the flame spread index and smoke-developed index limitations do not apply to the facings, provided that the facing is installed in substantial contact with the unexposed surface of the ceiling, floor or wall finish.
  2. Cellulose loose-fill insulation, which is not spray applied, complying with the requirements of Section R302.10.3, shall only be required to meet the smoke-developed index of not more than 450.
- 14) R302.10.2. Loose-fill insulation materials that cannot be mounted in the ASTM E 84 or UL 723 apparatus without a screen or artificial supports shall comply with the flame spread and smoke-developed limits of Section R302.10.1 when tested in accordance with CAN/ULC S102.2.
- Exception:** Cellulose loose-fill insulation shall not be required to be tested in accordance with CAN/ULC S102.2, provided such insulation complies with the requirements of Section R302.10.1 and Section R302.10.3.
- 15) R302.10.3 Cellulose loose-fill insulation. Cellulose loose-fill insulation shall comply with CPSC 16 CFR, Parts 1209 and 1404. Each package of such insulating material shall be clearly labeled in accordance with CPSC 16 CFR, Parts 1209 and 1404.
- 16) R302.10.4. All exposed insulation materials installed on attic floors shall have a critical radiant flux not less than 0.12 watt per square centimeter. Tests for critical radiant flux shall be made in accordance with ASTM E 970.
- 17) R302.11 . In combustible construction, fireblocking shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top story and the roof space.
- Fireblocking shall be provided in wood-frame construction in the following locations:
1. In concealed spaces of stud walls and partitions, including furred spaces and parallel rows of studs or staggered studs, as follows:
    - 1.1. Vertically at the ceiling and floor levels.
    - 1.2. Horizontally at intervals not exceeding 10 feet.
  2. At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings and cove ceilings.
  3. In concealed spaces between stair stringers at the top and bottom of the run. Enclosed spaces under stairs shall comply with Section R302.7.
  4. At openings around vents, pipes, ducts, cables and wires at ceiling and floor level, with an approved material to resist the free passage of flame and products of combustion. The material filling this annular space shall not be required to meet the ASTM E 136 requirements.
  5. For the fireblocking of chimneys and fireplaces, see Section R1003.19.
  6. Fireblocking of cornices of a two-family dwelling is required at the line of dwelling unit separation.
- 18) R302.11.1. Except as provided in Section R302.11, Item 4, fireblocking shall consist of the following materials.
1. Two-inch nominal lumber.
  2. Two thicknesses of 1-inch nominal lumber with broken lap joints.
  3. One thickness of  $\frac{23}{32}$ -inch wood structural panels with joints backed by  $\frac{23}{32}$ -inch wood structural panels.
  4. One thickness of  $\frac{3}{4}$ -inch particleboard with joints backed by  $\frac{3}{4}$ -inch particleboard.
  5. One-half-inch gypsum board.
  6. One-quarter-inch cement-based millboard.
  7. Batts or blankets of mineral wool or glass fiber or other approved materials installed in such a manner as to be securely retained in place.

- 19) R302.11.1.1. Batts or blankets of mineral or glass fiber or other approved nonrigid materials shall be permitted for compliance with the 10-foot horizontal fireblocking in walls constructed using parallel rows of studs or staggered studs.
- 20) R302.11.1.2. Unfaced fiberglass batt insulation used as fireblocking shall fill the entire cross section of the wall cavity to a minimum height of 16 inches measured vertically. When piping, conduit or similar obstructions are encountered, the insulation shall be packed tightly around the obstruction.
- 21) R302.11.1.3. Loose-fill insulation material shall not be used as a fireblock unless specifically tested in the form and manner intended for use to demonstrate its ability to remain in place and to retard the spread of fire and hot gases.
- 22) R302.11.2. The integrity of all fireblocks shall be maintained.
- 23) R302.12. In combustible construction where there is usable space both above and below the concealed space of a floor/ceiling assembly, draftstops shall be installed so that the area of the concealed space does not exceed 1,000 square feet. Draftstopping shall divide the concealed space into approximately equal areas. Where the assembly is enclosed by a floor membrane above and a ceiling membrane below, draftstopping shall be provided in floor/ceiling assemblies under the following circumstances:
1. Ceiling is suspended under the floor framing.
  2. Floor framing is constructed of truss-type open-web or perforated members.
- 24) R302.12.1. Draftstopping materials shall not be less than  $\frac{1}{2}$ -inch gypsum board,  $\frac{3}{8}$ -inch wood structural panels or other approved materials adequately supported. Draftstopping shall be installed parallel to the floor framing members unless otherwise approved by the building official. The integrity of the draftstops shall be maintained.
- 25) R302.13. Combustible insulation shall be separated a minimum of 3 inches from recessed luminaires, fan motors and other heat-producing devices.
- Exception:** Where heat-producing devices are listed for lesser clearances, combustible insulation complying with the listing requirements shall be separated in accordance with the conditions stipulated in the listing. Recessed luminaires installed in the building thermal envelope shall meet the requirements of Section N1102.4.5.
- 26) R303.1. All habitable rooms shall have an aggregate glazing area of not less than 8 percent of the floor area of such rooms. Natural ventilation shall be through windows, doors, louvers or other approved openings to the outdoor air. Such openings shall be provided with ready access or shall otherwise be readily controllable by the building occupants. The minimum openable area to the outdoors shall be 4 percent of the floor area being ventilated.
- Exceptions:**
1. The glazed areas need not be openable where the opening is not required by Section R310 and an approved mechanical ventilation system capable of producing 0.35 air change per hour in the room is installed or a whole-house mechanical ventilation system is installed capable of supplying outdoor ventilation air of 15 cubic feet per minute (cfm) per occupant computed on the basis of two occupants for the first bedroom and one occupant for each additional bedroom.
  2. The glazed areas need not be installed in rooms where Exception 1 above is satisfied and artificial light is provided capable of producing an average illumination of 6 foot-candles (65 lux) over the area of the room at a height of 30 inches above the floor level.
  3. Use of sunroom additions and patio covers, as defined in Section R202, shall be permitted for natural ventilation if in excess of 40 percent of the exterior sunroom walls are open, or are enclosed only by insect screening.
- 27) R303.2. For the purpose of determining light and ventilation requirements, any room shall be considered as a portion of an adjoining room when at least one-half of the area of the common wall is open and unobstructed and provides an opening of not less than one-tenth of the floor area of the interior room but not less than 25 square feet.

**Exception:** Openings required for light and/or ventilation shall be permitted to open into a thermally isolated sunroom addition or patio cover, provided that there is an openable area between the adjoining room and the sunroom addition or patio cover of not less than one-tenth of the floor area of the interior room but not less than 20 square feet. The minimum openable area to the outdoors shall be based upon the total floor area being ventilated.

- 28) R303.3. Bathrooms, water closet compartments and other similar rooms shall be provided with aggregate glazing area in windows of not less than 3 square feet, one-half of which must be openable.  
**Exception:** The glazed areas shall not be required where artificial light and a mechanical ventilation system are provided. The minimum ventilation rates shall be 50 cubic feet per minute for intermittent ventilation or 20 cubic feet per minute for continuous ventilation. Ventilation air from the space shall be exhausted directly to the outside.
- 29) R303.4.1. Mechanical and gravity outdoor air intake openings shall be located a minimum of 10 feet from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code. Where a source of contaminant is located within 10 feet of an intake opening, such opening shall be located a minimum of 2 feet below the contaminant source. For the purpose of this section, the exhaust from dwelling unit toilet rooms, bathrooms and kitchens shall not be considered as hazardous or noxious.
- 30) R303.4.2. Exhaust air shall not be directed onto walkways.
- 31) R303.5. Air exhaust and intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of  $\frac{1}{4}$  inch and a maximum opening size of  $\frac{1}{2}$  inch, in any dimension. Openings shall be protected against local weather conditions. Outdoor air exhaust and intake openings shall meet the provisions for exterior wall opening protection in accordance with this code.
- 32) R303.6. All interior and exterior stairways shall be provided with a means to illuminate the stairs, including the landings and treads. Interior stairways shall be provided with an artificial light source located in the immediate vicinity of each landing of the stairway. For interior stairs the artificial light sources shall be capable of illuminating treads and landings to levels not less than 1 foot-candle (11 lux) measured at the center of treads and landings. Exterior stairways shall be provided with an artificial light source located in the immediate vicinity of the top landing of the stairway. Exterior stairways providing access to a basement from the outside grade level shall be provided with an artificial light source located in the immediate vicinity of the bottom landing of the stairway.  
**Exception:** An artificial light source is not required at the top and bottom landing, provided an artificial light source is located directly over each stairway section.
- 33) R303.6.1. Where lighting outlets are installed in interior stairways, there shall be a wall switch at each floor level to control the lighting outlet where the stairway has six or more risers. The illumination of exterior stairways shall be controlled from inside the dwelling unit.  
**Exception:** Lights that are continuously illuminated or automatically controlled.
- 34) R303.7. Required glazed openings shall open directly onto a street or public alley, or a yard or court located on the same lot as the building.  
**Exceptions:**  
1. Required glazed openings may face into a roofed porch where the porch abuts a street, yard or court and the longer side of the porch is at least 65 percent unobstructed and the ceiling height is not less than 7 feet.  
2. Eave projections shall not be considered as obstructing the clear open space of a yard or court.  
3. Required glazed openings may face into the area under a deck, balcony, bay or floor cantilever provided a clear vertical space at least 36 inches in height is provided.
- 35) R303.7.1. Required glazed openings shall be permitted to open into sunroom additions or patio covers that abut a street, yard or court if in excess of 40 percent of the exterior sunroom walls are open, or are enclosed only by insect screening, and the ceiling height of the sunroom is not less than 7 feet.

- 36) R303.8. Every dwelling unit shall be provided with heating facilities capable of maintaining a minimum room temperature of 68°F at a point 3 feet above the floor and 2 feet from exterior walls in all habitable rooms at the design temperature. The installation of one or more portable space heaters shall not be used to achieve compliance with this section.
- 37) R304. Every dwelling unit shall have at least one habitable room that shall have not less than 120 square feet of gross floor area.
- 38) R304.2. Other habitable rooms shall have a floor area of not less than 70 square feet.  
**Exception:** Kitchens.
- 39) R304.3. Habitable rooms shall not be less than 7 feet in any horizontal dimension.  
**Exception:** Kitchens.
- 40) R304.4. Portions of a room with a sloping ceiling measuring less than 5 feet or a furred ceiling measuring less than 7 feet from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required habitable area for that room.
- 41) R305.1 (Amended). Habitable space, hallways, corridors, bathrooms, toilet rooms, laundry rooms and portions of basements containing these spaces shall have a ceiling height of not less than 7 feet. The required height shall be measured from the finished floor to the lowest projection of the ceiling.  
**Exception:**  
1. Not more than 50% of the floor area of a room or space is permitted to have a sloped ceiling less than 7 feet in height. Any floor area having less than 5 feet of ceiling height shall not be considered part of the room area and shall not be allowed to have any permanent fixtures or furnishings such as, but not limited to, bathtubs, showers, water closets, sinks, cabinets, counters and shelves.  
2. Bathrooms shall have a minimum ceiling height of 6 feet 8 inches over the fixture and at the front clearance area for fixtures as shown in Figure R307.1. A shower or tub equipped with a showerhead shall have a minimum ceiling height of 6 feet 8 inches above a minimum area 30 inches by 30 inches at the showerhead.  
3. Portions of basements that do not contain habitable space, hallways, bathrooms, toilet rooms and laundry rooms shall have a ceiling height not less than 6'8". Beams, girders, ducts or other obstructions in basements may project to within 6'4" of the finished floor.
- 42) R306.1. Every dwelling unit shall be provided with a water closet, lavatory, and a bathtub or shower.
- 43) R306.2. Each dwelling unit shall be provided with a kitchen area and every kitchen area shall be provided with a sink.
- 44) R306.3. All plumbing fixtures shall be connected to a sanitary sewer or to an approved private sewage disposal system.
- 45) R306.4. All plumbing fixtures shall be connected to an approved water supply. Kitchen sinks, lavatories, bathtubs, showers, bidets, laundry tubs and washing machine outlets shall be provided with hot and cold water.
- 46) R308.1. Except as indicated in Section R308.1.1 each pane of glazing installed in hazardous locations as defined in Section R308.4 shall be provided with a manufacturer's designation specifying who applied the designation, designating the type of glass and the safety glazing standard with which it complies, which is visible in the final installation. The designation shall be acid etched, sandblasted, ceramic-fired, laser etched, embossed, or be of a type which once applied cannot be removed without being destroyed. A label shall be permitted in lieu of the manufacturer's designation.  
**Exceptions:**  
1. For other than tempered glass, manufacturer's designations are not required provided the building official approves the use of a certificate, affidavit or other evidence confirming compliance with this code.  
2. Tempered spandrel glass is permitted to be identified by the manufacturer with a removable paper designation.

- 47) R308.1.1. Multipane assemblies having individual panes not exceeding 1 square foot in exposed area shall have at least one pane in the assembly identified in accordance with Section R308.1. All other panes in the assembly shall be labeled "CPSC 16 CFR 1201" or "ANSI Z97.1" as appropriate.
- 48) R308.2. Regular, float, wired or patterned glass in jalousies and louvered windows shall be no thinner than nominal  $\frac{3}{16}$  inch and no longer than 48 inches. Exposed glass edges shall be smooth.
- 49) R308.2.1. Wired glass with wire exposed on longitudinal edges shall not be used in jalousies or louvered windows.
- 50) R308.3. Individual glazed areas, including glass mirrors in hazardous locations such as those indicated as defined in Section R308.4, shall pass the test requirements of Section R308.3.1.
- Exceptions:**
1. Louvered windows and jalousies shall comply with Section R308.2.
  2. Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support.
  3. Glass unit masonry complying with Section R610.
- 51) R308.4. The following shall be considered specific hazardous locations for the purposes of glazing:
1. Glazing in all fixed and operable panels of swinging, sliding and bifold doors.
- Exceptions:**
1. Glazed openings of a size through which a 3-inch diameter sphere is unable to pass.
  2. Decorative glazing.
2. Glazing in an individual fixed or operable panel adjacent to a door where the nearest vertical edge is within a 24-inch arc of the door in a closed position and whose bottom edge is less than 60 inches above the floor or walking surface.
- Exceptions:**
1. Decorative glazing.
  2. When there is an intervening wall or other permanent barrier between the door and the glazing.
  3. Glazing in walls on the latch side of and perpendicular to the plane of the door in a closed position.
  4. Glazing adjacent to a door where access through the door is to a closet or storage area 3 feet or less in depth.
  5. Glazing that is adjacent to the fixed panel of patio doors.
3. Glazing in an individual fixed or operable panel that meets all of the following conditions:
- 3.1. The exposed area of an individual pane is larger than 9 square feet; and
  - 3.2. The bottom edge of the glazing is less than 18 inches above the floor; and
  - 3.3. The top edge of the glazing is more than 36 inches above the floor; and
  - 3.4. One or more walking surfaces are within 36 inches, measured horizontally and in a straight line, of the glazing.
- Exceptions:**
1. Decorative glazing.
  2. When a horizontal rail is installed on the accessible side(s) of the glazing 34 to 38 inches above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds per linear foot without contacting the glass and be a minimum of  $1\frac{1}{2}$  inches in cross sectional height.
  3. Outboard panes in insulating glass units and other multiple glazed panels when the bottom edge of the glass is 25 feet or more above grade, a roof, walking surfaces or other horizontal [within 45 degrees of horizontal] surface adjacent to the glass exterior.
4. All glazing in railings regardless of area or height above a walking surface. Included are structural baluster panels and nonstructural infill panels.
5. Glazing in enclosures for or walls facing hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers where the bottom exposed edge of the glazing is less than 60 inches measured vertically above any standing or walking surface.



**Exception:** Glazing that is more than 60 inches, measured horizontally and in a straight line, from the waters edge of a hot tub, whirlpool or bathtub.

6. Glazing in walls and fences adjacent to indoor and outdoor swimming pools, hot tubs and spas where the bottom edge of the glazing is less than 60 inches above a walking surface and within 60 inches, measured horizontally and in a straight line, of the water's edge. This shall apply to single glazing and all panes in multiple glazing.

7. Glazing adjacent to stairways, landings and ramps within 36 inches horizontally of a walking surface when the exposed surface of the glazing is less than 60 inches above the plane of the adjacent walking surface.

**Exceptions:**

1. When a rail is installed on the accessible side(s) of the glazing 34 to 38 inches above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds per linear foot without contacting the glass and be a minimum of 1½ inches in cross sectional height.

2. The side of the stairway has a guardrail or handrail, including balusters or in-fill panels, complying with Sections R311.7.6 and R312 and the plane of the glazing is more than 18 inches from the railing; or

3. When a solid wall or panel extends from the plane of the adjacent walking surface to 34 inches to 36 inches above the walking surface and the construction at the top of that wall or panel is capable of withstanding the same horizontal load as a guard.

8. Glazing adjacent to stairways within 60 inches horizontally of the bottom tread of a stairway in any direction when the exposed surface of the glazing is less than 60 inches above the nose of the tread.

**Exceptions:**

1. The side of the stairway has a guardrail or handrail, including balusters or in-fill panels, complying with Sections R311.7.6 and R312 and the plane of the glass is more than 18 inches from the railing; or

2. When a solid wall or panel extends from the plane of the adjacent walking surface to 34 inches to 36 inches above the walking surface and the construction at the top of that wall or panel is capable of withstanding the same horizontal load as a guard.

52) R308.6.8 Curbs for skylights. All unit skylights installed in a roof with a pitch flatter than three units vertical in 12 units horizontal (25-percent slope) shall be mounted on a curb extending at least 4 inches (102 mm) above the plane of the roof unless otherwise specified in the manufacturer's installation instructions.

53) R308.6.9 Testing and labeling. Unit skylights shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance grade rating and approved inspection agency to indicate compliance with the requirements of AAMA/WDMA/CSA 101/I.S.2/A440.

54) R310.1. Basements, habitable attics and every sleeping room shall have at least one operable emergency escape and rescue opening. Where basements contain one or more sleeping rooms, emergency egress and rescue openings shall be required in each sleeping room. Where emergency escape and rescue openings are provided they shall have a sill height of not more than 44 inches above the floor. Where a door opening having a threshold below the adjacent ground elevation serves as an emergency escape and rescue opening and is provided with a bulkhead enclosure, the bulkhead enclosure shall comply with Section R310.3. The net clear opening dimensions required by this section shall be obtained by the normal operation of the emergency escape and rescue opening from the inside. Emergency escape and rescue openings with a finished sill height below the adjacent ground elevation shall be provided with a window well in accordance with Section R310.2. Emergency escape and rescue openings shall open directly into a public way, or to a yard or court that opens to a public way.

**Exception:** Basements used only to house mechanical equipment and not exceeding total floor area of 200 square feet.

55) R310.1.1. All emergency escape and rescue openings shall have a minimum net clear opening of 5.7 square feet.

**Exception:** Grade floor openings shall have a minimum net clear opening of 5 square feet.

56) R310.1.2. The minimum net clear opening height shall be 24 inches.

- 57) R310.1.3. The minimum net clear opening width shall be 20 inches.
- 58) R310.1.4. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys, tools or special knowledge.
- 59) R310.2. The minimum horizontal area of the window well shall be 9 square feet, with a minimum horizontal projection and width of 36 inches. The area of the window well shall allow the emergency escape and rescue opening to be fully opened.  
**Exception:** The ladder or steps required by Section R310.2.1 shall be permitted to encroach a maximum of 6 inches into the required dimensions of the window well.
- 60) R310.2.1. Window wells with a vertical depth greater than 44 inches shall be equipped with a permanently affixed ladder or steps usable with the window in the fully open position. Ladders or rungs shall have an inside width of at least 12 inches, shall project at least 3 inches from the wall and shall be spaced not more than 18 inches on center vertically for the full height of the window well.
- 61) R310.4. Bars, grilles, covers, screens or similar devices are permitted to be placed over emergency escape and rescue openings, bulkhead enclosures, or window wells that serve such openings, provided the minimum net clear opening size complies with Sections R310.1.1 to R310.1.3, and such devices shall be releasable or removable from the inside without the use of a key, tool, special knowledge or force greater than that which is required for normal operation of the escape and rescue opening.
- 62) R310.5. Emergency escape windows are allowed to be installed under decks and porches provided the location of the deck allows the emergency escape window to be fully opened and provides a path not less than 36 inches in height to a yard or court.
- 63) R311.1. All dwellings shall be provided with a means of egress as provided in this section. The means of egress shall provide a continuous and unobstructed path of vertical and horizontal egress travel from all portions of the dwelling to the exterior of the dwelling at the required egress door without requiring travel through a garage.
- 64) R311.2. At least one egress door shall be provided for each dwelling unit. The egress door shall be side-hinged, and shall provide a minimum clear width of 32 inches when measured between the face of the door and the stop, with the door open 90 degrees. The minimum clear height of the door opening shall not be less than 78 inches in height measured from the top of the threshold to the bottom of the stop. Other doors shall not be required to comply with these minimum dimensions. Egress doors shall be readily openable from inside the dwelling without the use of a key or special knowledge or effort.
- 65) R311.3. There shall be a landing or floor on each side of each exterior door. The width of each landing shall not be less than the door served. Every landing shall have a minimum dimension of 36 inches measured in the direction of travel. Exterior landings shall be permitted to have a slope not to exceed  $\frac{1}{4}$  unit vertical in 12 units horizontal (2-percent).  
**Exception:** Exterior balconies less than 60 square feet, only accessible from a door, are permitted to have a landing less than 36 inches measured in the direction of travel.
- 66) R311.3.1. Landings or floors at the required egress door shall not be more than  $1\frac{1}{2}$  inches lower than the top of the threshold.  
**Exception:** The exterior landing or floor shall not be more than  $7\frac{3}{4}$  inches below the top of the threshold provided the door does not swing over the landing or floor.  
When exterior landings or floors serving the required egress door are not at grade, they shall be provided with access to grade by means of a ramp in accordance with Section R311.8 or a stairway in accordance with Section R311.7.
- 67) R311.3.2. Doors other than the required egress door shall be provided with landings or floors not more than  $7\frac{3}{4}$  inches below the top of the threshold.

**Exception:** A landing is not required where a stairway of two or fewer risers is located on the exterior side of the door, provided the door does not swing over the stairway.

- 68) R311.3.3. Storm and screen doors shall be permitted to swing over all exterior stairs and landings.
- 69) R311.4. Egress from habitable levels including habitable attics and basements not provided with an egress door in accordance with Section R311.2 shall be by a ramp in accordance with Section R311.8 or a stairway in accordance with Section R311.7.
- 70) R311.6. The minimum width of a hallway shall be not less than 3 feet.
- 71) R311.7.1. Stairways shall not be less than 36 inches in clear width at all points above the permitted handrail height and below the required headroom height. Handrails shall not project more than 4.5 inches on either side of the stairway and the minimum clear width of the stairway at and below the handrail height, including treads and landings, shall not be less than  $31\frac{1}{2}$  inches where a handrail is installed on one side and 27 inches where handrails are provided on both sides.  
**Exception:** The width of spiral stairways shall be in accordance with Section R311.7.9.1.
- 72) R311.7.2. The minimum headroom in all parts of the stairway shall not be less than 6 feet 8 inches measured vertically from the sloped line adjoining the tread nosing or from the floor surface of the landing or platform on that portion of the stairway.  
**Exception:** Where the nosing of treads at the side of a flight extend under the edge of a floor opening through which the stair passes, the floor opening shall be allowed to project horizontally into the required headroom a maximum of  $4\frac{3}{4}$  inches.
- 73) R311.7.4. Stair treads and risers shall meet the requirements of this section. For the purposes of this section all dimensions and dimensioned surfaces shall be exclusive of carpets, rugs or runners.
- 74) R311.7.4.1. The maximum riser height shall be  $7\frac{3}{4}$  inches. The riser shall be measured vertically between leading edges of the adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than  $\frac{3}{8}$  inch.
- 75) R311.7.4.2. The minimum tread depth shall be 10 inches. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than  $\frac{3}{8}$  inch. Consistently shaped winders at the walk line shall be allowed within the same flight of stairs as rectangular treads and do not have to be within  $\frac{3}{8}$  inch of the rectangular tread depth.
- Winder treads shall have a minimum tread depth of 10 inches measured between the vertical planes of the foremost projection of adjacent treads at the intersections with the walk line. Winder treads shall have a minimum tread depth of 6 inches at any point within the clear width of the stair. Within any flight of stairs, the largest winder tread depth at the walk line shall not exceed the smallest winder tread by more than  $\frac{3}{8}$  inch.
- 76) R311.7.4.3. The radius of curvature at the nosing shall be no greater than  $\frac{9}{16}$  inch. A nosing not less than  $\frac{3}{4}$  inch but not more than  $1\frac{1}{4}$  inches shall be provided on stairways with solid risers. The greatest nosing projection shall not exceed the smallest nosing projection by more than  $\frac{3}{8}$  inch between two stories, including the nosing at the level of floors and landings. Beveling of nosings shall not exceed  $\frac{1}{2}$  inch. Risers shall be vertical or sloped under the tread above from the underside of the nosing above at an angle not more than 30 degrees from the vertical. Open risers are permitted, provided that the opening between treads does not permit the passage of a 4-inch diameter sphere.  
**Exceptions:**  
1. A nosing is not required where the tread depth is a minimum of 11 inches.  
2. The opening between adjacent treads is not limited on stairs with a total rise of 30 inches or less.
- 77) R311.7.5. There shall be a floor or landing at the top and bottom of each stairway.

**Exception:** A floor or landing is not required at the top of an interior flight of stairs, including stairs in an enclosed garage, provided a door does not swing over the stairs. A flight of stairs shall not have a vertical rise larger than 12 feet between floor levels or landings. The width of each landing shall not be less than the width of the stairway served. Every landing shall have a minimum dimension of 36 inches measured in the direction of travel.

- 78) R311.7.7. Handrails shall be provided on at least one side of each continuous run of treads or flight with four or more risers.
- 79) R311.7.7.1. Handrail height, measured vertically from the sloped plane adjoining the tread nosing, or finish surface of ramp slope, shall be not less than 34 inches and not more than 38 inches.
- Exceptions:**
1. The use of a volute, turnout or starting easing shall be allowed over the lowest tread.
  2. When handrail fittings or bendings are used to provide continuous transition between flights, the transition from handrail to guardrail, or used at the start of a flight, the handrail height at the fittings or bendings shall be permitted to exceed the maximum height.
- 80) R311.7.7.2. Handrails for stairways shall be continuous for the full length of the flight, from a point directly above the top riser of the flight to a point directly above the lowest riser of the flight. Handrail ends shall be returned or shall terminate in newel posts or safety terminals. Handrails adjacent to a wall shall have a space of not less than  $1\frac{1}{2}$  inch between the wall and the handrails.
- Exceptions:**
1. Handrails shall be permitted to be interrupted by a newel post at the turn.
  2. The use of a volute, turnout, starting easing or starting newel shall be allowed over the lowest tread.
- 81) R311.7.7.3. All required handrails shall be of one of the following types or provide equivalent graspability.
1. Type I. Handrails with a circular cross section shall have an outside diameter of at least  $1\frac{1}{4}$  inches and not greater than 2 inches. If the handrail is not circular, it shall have a perimeter dimension of at least 4 inches and not greater than  $6\frac{1}{4}$  inches with a maximum cross section of dimension of  $2\frac{1}{4}$  inches. Edges shall have a minimum radius of 0.01 inch.
  2. Type II. Handrails with a perimeter greater than  $6\frac{1}{4}$  inches shall have a graspable finger recess area on both sides of the profile. The finger recess shall begin within a distance of  $\frac{3}{4}$  inch measured vertically from the tallest portion of the profile and achieve a depth of at least  $\frac{5}{16}$  inch within  $\frac{7}{8}$  inch below the widest portion of the profile. This required depth shall continue for at least  $\frac{3}{8}$  inch to a level that is not less than  $1\frac{3}{4}$  inches below the tallest portion of the profile. The minimum width of the handrail above the recess shall be  $1\frac{1}{4}$  inches to a maximum of  $2\frac{3}{4}$  inches. Edges shall have a minimum radius of 0.01 inch.
- 82) R311.7.9.1. Spiral stairways are permitted, provided the minimum clear width at and below the handrail shall be 26 inches with each tread having a  $7\frac{1}{2}$ -inch minimum tread depth at 12 inches from the narrower edge. All treads shall be identical, and the rise shall be no more than  $9\frac{1}{2}$  inches. A minimum headroom of 6 feet 6 inches shall be provided.
- 83) R311.8.1. Ramps shall have a maximum slope of 1 unit vertical in 12 units horizontal (8.3 percent slope).
- Exception:** Where it is technically infeasible to comply because of site constraints, ramps may have a maximum slope of one unit vertical in eight horizontal (12.5 percent slope).
- 84) R311.8.2. A minimum 3-foot-by-3-foot landing shall be provided:
1. At the top and bottom of ramps.
  2. Where doors open onto ramps.
  3. Where ramps change direction.
- 85) R311.8.3. Handrails shall be provided on at least one side of all ramps exceeding a slope of one unit vertical in 12 units horizontal (8.33-percent slope).
- 86) R311.8.3.1. Handrail height, measured above the finished surface of the ramp slope, shall be not less than 34 inches and not more than 38 inches.

- 87) R311.8.3.2. Handrails on ramps shall comply with Section R311.7.7.3.
- 88) R311.8.3.3. Handrails where required on ramps shall be continuous for the full length of the ramp. Handrail ends shall be returned or shall terminate in newel posts or safety terminals. Handrails adjacent to a wall shall have a space of not less than 1<sup>1</sup>/<sub>2</sub> inches between the wall and the handrails.
- 89) R312.1 (Amended). Guards shall be located along open-sided walking surfaces, including stairs, ramps and landings, that are located more than 30 inches measured vertically to the floor or grade below and retaining walls with a difference in grade level on either side of the wall exceeding 30 inches and within 2 feet of a walk, path, parking lot or driveway on the high side at any point within 36 inches horizontally to the edge of the open side. Insect screening shall not be considered as a guard.
- 90) R312.2. Required guards at open-sided walking surfaces, including stairs, porches, balconies or landings, shall be not less than 36 inches high measured vertically above the adjacent walking surface, adjacent fixed seating or the line connecting the leading edges of the treads.  
**Exceptions:**  
1. Guards on the open sides of stairs shall have a height not less than 34 inches measured vertically from a line connecting the leading edges of the treads.  
2. Where the top of the guard also serves as a handrail on the open sides of stairs, the top of the guard shall not be not less than 34 inches and not more than 38 inches measured vertically from a line connecting the leading edges of the treads.
- 91) R312.3. Required guards shall not have openings from the walking surface to the required guard height which allow passage of a sphere 4 inches in diameter.  
**Exceptions:**  
1. The triangular openings at the open side of a stair, formed by the riser, tread and bottom rail of a guard, shall not allow passage of a sphere 6 inches in diameter.  
inches in diameter.
- 92) R313.1. An automatic residential fire sprinkler system shall be installed in townhouses. **Exception:** An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing townhouses that do not have an automatic residential fire sprinkler system installed.
- 93) R313.1.1. (Amended) Automatic residential fire sprinkler systems for townhouses shall be designed and installed in accordance with NFPA 13D.
- 94) R313.2. An automatic residential fire sprinkler system shall be installed in one- and two- family dwellings.  
**Exception:** An automatic residential fire sprinkler system shall not be required for additions or alterations to existing buildings that are not already provided with an automatic residential sprinkler system.
- 95) R313.2.1. (Amended) Automatic residential fire sprinkler systems shall be designed and installed in accordance with NFPA 13D.
- 96) R313.3. (Amended) Rehabilitation work in one and two family dwellings and townhouses equipped with an approved sprinkler system. An approved automatic fire sprinkler system shall be maintained in areas undergoing rehabilitation work.
- 97) R313.4. (Amended) Automatic sprinkler system for reconstruction. An approved automatic fire sprinkler system shall be installed when 50% or more of the gross floor area as defined in section 1002.1 of the IBC of the existing building is demolished.
- 98) R314.1. All smoke alarms shall be listed in accordance with UL 217 and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.

- 99) R314.2. Household fire alarm systems installed in accordance with NFPA 72 that include smoke alarms, or a combination of smoke detector and audible notification device installed as required by this section for smoke alarms, shall be permitted. The household fire alarm system shall provide the same level of smoke detection and alarm as required by this section for smoke alarms. Where a household fire warning system is installed using a combination of smoke detector and audible notification device(s), it shall become a permanent fixture of the occupancy and owned by the homeowner. The system shall be monitored by an approved supervising station and be maintained in accordance with NFPA 72. **Exception:** Where smoke alarms are provided meeting the requirements of Section R314.4.
- 100) R314.3. Smoke alarms shall be installed in the following locations:
1. In each sleeping room.
  2. Outside each separate sleeping area in the immediate vicinity of the bedrooms.
  3. On each additional story of the dwelling, including basements and habitable attics but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level. When more than one smoke alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit.
- 101) R314.3.1. When alterations, repairs or additions requiring a permit occur, or when one or more sleeping rooms are added or created in existing dwellings, the individual dwelling unit shall be equipped with smoke alarms located as required for new dwellings. **Exceptions:**
1. Work involving the exterior surfaces of dwellings, such as the replacement of roofing or siding, or the addition or replacement of windows or doors, or the addition of a porch or deck, are exempt from the requirements of this section.
  2. Installation, alteration or repairs of plumbing or mechanical systems are exempt from the requirements of this section.
- 102) R314.4. Smoke alarms shall receive their primary power from the building wiring when such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than those required for overcurrent protection. Smoke alarms shall be interconnected. **Exceptions:**
1. Smoke alarms shall be permitted to be battery operated when installed in buildings without commercial power.
  2. Interconnection and hard-wiring of smoke alarms in existing areas shall not be required where the alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for hard wiring and interconnection without the removal of interior finishes.
- 103) R315.1. For new construction, an approved carbon monoxide alarm shall be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in dwelling units within which fuel-fired appliances are installed and in dwelling units that have attached garages.
- 104) R315.2. Where work requiring a permit occurs in existing dwellings that have attached garages or in existing dwellings within which fuel-fired appliances exist, carbon monoxide alarms shall be provided in accordance with Section R315.1.
- 105) R315.3. Single station carbon monoxide alarms shall be listed as complying with UL 2034 and shall be installed in accordance with this code and the manufacturer's installation instructions.
- 106) R317.1. Protection of wood and wood based products from decay shall be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 for the species, product, preservative and end use. Preservatives shall be listed in Section 4 of AWPA U1.
1. Wood joists or the bottom of a wood structural floor when closer than 18 inches or wood girders when closer than 12 inches to the exposed ground in crawl spaces or unexcavated area located within the periphery of the building foundation.

2. All wood framing members that rest on concrete or masonry exterior foundation walls and are less than 8 inches from the exposed ground.
  3. Sills and sleepers on a concrete or masonry slab that is in direct contact with the ground unless separated from such slab by an impervious moisture barrier.
  4. The ends of wood girders entering exterior masonry or concrete walls having clearances of less than  $\frac{1}{2}$  inch on tops, sides and ends.
  5. Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less than 6 inches from the ground or less than 2 inches measured vertically from concrete steps, porch slabs, patio slabs, and similar horizontal surfaces exposed to the weather.
  6. Wood structural members supporting moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, unless separated from such floors or roofs by an impervious moisture barrier.
  7. Wood furring strips or other wood framing members attached directly to the interior of exterior masonry walls or concrete walls below grade except where an approved vapor retarder is applied between the wall and the furring strips or framing members.
- 107) R317.1.1. Field-cut ends, notches and drilled holes of preservative-treated wood shall be treated in the field in accordance with AWP M4.
- 108) R317.1.2. All wood in contact with the ground, embedded in concrete in direct contact with the ground or embedded in concrete exposed to the weather that supports permanent structures intended for human occupancy shall be approved pressure-preservative-treated wood suitable for ground contact use, except untreated wood may be used where entirely below groundwater level or continuously submerged in fresh water.
- 109) R317.1.4. Wood columns shall be approved wood of natural decay resistance or approved pressure-preservative-treated wood. **Exceptions:**
1. Columns exposed to the weather or in basements when supported by concrete piers or metal pedestals projecting 1 inch above a concrete floor or 6 inches above exposed earth and the earth is covered by an approved impervious moisture barrier.
  2. Columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building when supported by a concrete pier or metal pedestal at a height more than 8 inches from exposed earth and the earth is covered by an impervious moisture barrier.
- 110) R317.1.5. The portions of glued-laminated timbers that form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave or similar covering shall be pressure treated with preservative, or be manufactured from naturally durable or preservative-treated wood.
- 111) R317.3.1 Fasteners for preservative-treated wood shall be of hot dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Coating types and weights for connectors in contact with preservative-treated wood shall be in accordance with the connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A653 type G185 zinc-coated galvanized steel, or equivalent, shall be used.
- Exceptions:**
1. One-half-inch diameter or greater steel bolts.
  2. Fasteners other than nails and timber rivets shall be permitted to be of mechanically deposited zinc coated steel with coating weights in accordance with ASTM B695, Class 55 minimum.
- 112) R317.4. Wood/plastic composites used in exterior deck boards, stair treads, handrails and guardrail systems shall bear a label indicating the required performance levels and demonstrating compliance with the provisions of ASTM D7032.
- 113) R317.4.1 Wood/plastic composites shall be installed in accordance with the manufacturer's instructions.
- 114) R319.1. (Amended) Buildings shall have approved address numbers, building numbers or approved building identification placed in a position that is plainly legible and visible from the street or road fronting the property. These numbers shall contrast with their background. Address numbers shall be Arabic numbers or alphabetical

letters. Numbers shall be a minimum of 5 inches high with a minimum stroke width of 1/2 inch. Where access is by means of a private road and the building address cannot be viewed from the public way, a monument, pole or other sign or means shall be used to identify the structure.

- 115) R321.1. Where provided, passenger elevators, limited-use/limited-application elevators or private residence elevators shall comply with ASME A17.1. Walls and ceiling of elevator shafts shall be covered with not less than 5/8 inch Type X gypsum board.
- 116) R401.1. The provisions of this chapter shall control the design and construction of the foundation and foundation spaces for all buildings. In addition to the provisions of this chapter, the design and construction of foundations in areas prone to flooding as established by Table R301.2(1) shall meet the provisions of Section R322. Wood foundations shall be designed and installed in accordance with AF&PA PWF.  
**Exception:** The provisions of this chapter shall be permitted to be used for wood foundations only in the following situations:  
1. In buildings that have no more than two floors and a roof.  
2. When interior basement and foundation walls are constructed at intervals not exceeding 50 feet.
- 117) R401.2. Foundation construction shall be capable of accommodating all loads according to Section R301 and of transmitting the resulting loads to the supporting soil. Fill soils that support footings and foundations shall be designed, installed and tested in accordance with accepted engineering practice. Gravel fill used as footings for wood and precast concrete foundations shall comply with Section R403.
- 118) R401.3. Surface drainage shall be diverted to a storm sewer conveyance or other approved point of collection that does not create a hazard. Lots shall be graded to drain surface water away from foundation walls. The grade shall fall a minimum of 6 inches within the first 10 feet.  
**Exception:** Where lot lines, walls, slopes or other physical barriers prohibit 6 inches of fall within 10 feet, drains or swales shall be constructed to ensure drainage away from the structure. Impervious surfaces within 10 feet of the building foundation shall be sloped a minimum of 2 percent away from the building.
- 119) R401.5 (Amended). Special conditions. Design and construction of all buildings and structures within 1000 feet of a known municipal solid waste (MSW) landfill site that does not currently have an operational land fill gas (LFG) monitoring and removal system, shall require special engineering of foundation systems, including walls and floor slabs, to provide for the safety of the occupants against hazards from LFG concentration. Special subsurface investigations shall be conducted, at the owner's expense, by an approved and qualified engineer or geologist to determine the extent of the potential hazard. The study must identify the potential hazards, and mitigation plans for the site must be incorporated into the construction documents and approved prior to issuance of a building permit. All buildings and structures within 1000 feet of the boundary of a MSW landfill shall be equipped with a methane gas detector with an alarm activation level of 20% of the lower explosive limit (LEL-1% by volume).
- 120) R403.1. All exterior walls shall be supported on continuous solid or fully grouted masonry or concrete footings, crushed stone footings, wood foundations, or other approved structural systems which shall be of sufficient design to accommodate all loads according to Section R301 and to transmit the resulting loads to the soil within the limitations as determined from the character of the soil. Footings shall be supported on undisturbed natural soils or engineered fill. Concrete footing shall be designed and constructed in accordance with the provisions of Section R403 or in accordance with ACI 332.
- 121) R403.1.1. Minimum sizes for concrete and masonry footings shall be as set forth in Table R403.1 and Figure R403.1(1). The footing width, W, shall be based on the load-bearing value of the soil in accordance with Table R401.4.1. Spread footings shall be at least 6 inches in thickness, T. Footing projections, P, shall be at least 2 inches and shall not exceed the thickness of the footing. The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table R401.4.1. Footings for wood foundations shall be in accordance with the details set forth in Section R403.2, and Figures R403.1(2) and R403.1(3).



- 122) R403.1.3.1. Foundations with stem walls shall have installed a minimum of one No. 4 bar within 12 inches of the top of the wall and one No. 4 bar located 3 inches to 4 inches from the bottom of the footing.
- 123) R403.1.3.2. Slabs on ground with turned down footings shall have a minimum of one No. 4 bar at the top and the bottom of the footing.  
**Exception:** For slabs-on-ground cast monolithically with the footing, locating one No. 5 bar or two No. 4 bars in the middle third of the footing depth shall be permitted as an alternative to placement at the footing top and bottom.
- 124) R403.1.4. All exterior footings shall be placed at least 24 inches below the undisturbed ground surface. Where applicable, the depth of footings shall also conform to Sections R403.1.4.1 through R403.1.4.2.
- 125) R403.1.4.1. (Amended). Except where otherwise protected from frost, foundation walls, piers and other permanent supports of buildings and structures shall be protected from frost by one or more of the following methods:
1. Extended below the frost line (24 inches minimum);
  2. Constructing in accordance with Section R403.3;
  3. Constructing in accordance with ASCE 32; or
  4. Erected on solid rock.
- Exceptions:**
1. One-story detached accessory structures, excluding garages and carports, used as tool and storage sheds, playhouses and similar uses and not exceeding 400 square feet or less in floor area and an eave height of 10 feet or less shall not be required to be protected.
- 126) R403.1.5. The top surface of footings shall be level. The bottom surface of footings shall not have a slope exceeding one unit vertical in 10 units horizontal (10-percent slope). Footings shall be stepped where it is necessary to change the elevation of the top surface of the footings or where the slope of the bottom surface of the footings will exceed one unit vertical in ten units horizontal (10-percent slope).
- 127) R403.1.6. Sill plates and walls supported directly on continuous foundations shall be anchored to the foundation in accordance with this section. Wood sole plates at all exterior walls on monolithic slabs, wood sole plates of braced wall panels at building interiors on monolithic slabs and all wood sill plates shall be anchored to the foundation with anchor bolts spaced a maximum of 6 feet on center. Bolts shall be at least  $\frac{1}{2}$  inch in diameter and shall extend a minimum of 7 inches into concrete or grouted cells of concrete masonry units. A nut and washer shall be tightened on each anchor bolt. There shall be a minimum of two bolts per plate section with one bolt located not more than 12 inches or less than seven bolt diameters from each end of the plate section. Interior bearing wall sole plates on monolithic slab foundation that are not part of a braced wall panel shall be positively anchored with approved fasteners. Sill plates and sole plates shall be protected against decay and termites where required by Sections R317 and R318. Cold-formed steel framing systems shall be fastened to wood sill plates or anchored directly to the foundation as required in Section R505.3.1 or R603.3.1.
- Exceptions:**
1. Foundation anchorage, spaced as required to provide equivalent anchorage to  $\frac{1}{2}$ -inch-diameter anchor bolts.
  2. Walls 24 inches total length or shorter connecting offset braced wall panels shall be anchored to the foundation with a minimum of one anchor bolt located in the center third of the plate section and shall be attached to adjacent braced wall panels at corners as shown in Figure R602.10.4.4(1).
  3. Connection of walls 12 inches total length or shorter connecting offset braced wall panels to the foundation without anchor bolts shall be permitted. The wall shall be attached to adjacent braced wall panels at corners as shown in Figure R602.10.4.4(1).
- 128) R403.3.2. Horizontal insulation placed less than 12 inches below the ground surface or that portion of horizontal insulation extending outward more than 24 inches from the foundation edge shall be protected against damage by use of a concrete slab or asphalt paving on the ground surface directly above the insulation or by cementitious board, plywood rated for below-ground use, or other approved materials placed below ground, directly above the top surface of the insulation.

- 129) R403.4.1. Clean crushed stone shall be free from organic, clayey or silty soils. Crushed stone shall be angular in nature and meet ASTM C 33, with the maximum size stone not to exceed  $\frac{1}{2}$  inch and the minimum stone size not to be smaller than  $\frac{1}{16}$ -inch. Crushed stone footings for precast foundations shall be installed in accordance with Figure R403.4(1) and Table R403.4. Crushed stone footings shall be consolidated using a vibratory plate in a maximum of 8-inch lifts. Crushed stone footings shall be limited to Seismic Design Category B.
- 130) R404.1.2.3.1. The minimum specified compressive strength of concrete, shall comply with Section R402.2 and shall be not less than 2,500 psi at 28 days in buildings assigned to Seismic Design Category B.
- 131) R404.1.3. Concrete or masonry foundation walls shall be designed in accordance with accepted engineering practice when either of the following conditions exists:
1. Walls are subject to hydrostatic pressure from groundwater.
  2. Walls supporting more than 48 inches of unbalanced backfill that do not have permanent lateral support at the top or bottom.
- 132) R404.1.5.1. Masonry foundation walls shall not be less than the thickness of the wall supported, except that masonry foundation walls of at least 8-inch nominal thickness shall be permitted under brick veneered frame walls and under 10-inch-wide cavity walls where the total height of the wall supported, including gables, is not more than 20 feet, provided the requirements of Section R404.1.1 are met.
- 133) R404.1.6. Concrete and masonry foundation walls shall extend above the finished grade adjacent to the foundation at all points a minimum of 4 inches where masonry veneer is used and a minimum of 6 inches elsewhere.
- 134) R404.1.7. Backfill shall not be placed against the wall until the wall has sufficient strength and has been anchored to the floor above, or has been sufficiently braced to prevent damage by the backfill.  
**Exception:** Bracing is not required for walls supporting less than 4 feet of unbalanced backfill.
- 135) R404.4. Retaining walls that are not laterally supported at the top and that retain in excess of 24 inches of unbalanced fill shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Retaining walls shall be designed for a safety factor of 1.5 against lateral sliding and overturning.
- 136) R404.5.2. Precast concrete foundation wall design drawings shall be submitted to the building official and approved prior to installation. Drawings shall include, at a minimum, the information specified below:
1. Design loading as applicable;
  2. Footing design and material;
  3. Concentrated loads and their points of application;
  4. Soil bearing capacity;
  5. Maximum allowable total uniform load;
  6. Seismic design category; and
  7. Basic wind speed.
- 137) R404.5.3. Precast concrete foundation wall panels shall be identified by a certificate of inspection label issued by an approved third party inspection agency.
- 138) R405.1. (Amended). Concrete or Masonry foundations, Exterior drainage system. Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least 1 foot beyond the outside edge of the footing and 6 inches above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper, and the drainage tiles or perforated pipe shall be placed on a minimum of 2 inches of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than 6 inches of the same material.

- 139) R405.1(1). (Amended). Concrete or Masonry foundation interior drainage system. Weep holes at least 2 inches in diameter, spaced at a maximum of 6 feet on center shall be installed in the footing connecting into the interior drains. Weep hole inlets shall have a minimum of 6 inches of gravel for the full perimeter of the foundation, extending at least 12 inches from the inlets and covered by a layer of approved filter membrane.
- 140) R405.1.1. Precast concrete walls that retain earth and enclose habitable or useable space located below-grade that rest on crushed stone footings shall have a perforated drainage pipe installed below the base of the wall on either the interior or exterior side of the wall, at least one foot beyond the edge of the wall. If the exterior drainage pipe is used, an approved filter membrane material shall cover the pipe. The drainage system shall discharge into an approved sewer system or to daylight.
- 141) R405.2.1. A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of 4 inches under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.
- 142) R405.2.2. A 6-mil-thick polyethylene vapor retarder shall be applied over the porous layer with the basement floor constructed over the polyethylene.
- 143) R405.2.3. In other than Group I soils, a sump shall be provided to drain the porous layer and footings. The sump shall be at least 24 inches in diameter or 20 inches square, shall extend at least 24 inches below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water. The drainage system shall discharge into an approved sewer system or to daylight.
- 144) R406.2. (Amended). Exterior foundation walls retaining earth and enclosing usable spaces below grade must be waterproofed with an approved waterproofing system or a membrane extending from the top of the footings to finished grades. Waterproofing system shall be installed as required in the current International Code Council Evaluation Service Report for the product. Walls shall be waterproofed in accordance with one of the following:
1. Forty-mil polymer-modified asphalt.
  2. Sixty-mil flexible polymer cement.
  3. One-eighth inch cement-based, fiber-reinforced, waterproof coating.
  4. Sixty-mil solvent-free liquid-applied synthetic rubber.
- Exception:** Organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones and esters shall not be used for ICF walls with expanded polystyrene form material. Use of plastic roofing cements, acrylic coatings, latex coatings, mortars and pargings to seal ICF walls is permitted. Cold-setting asphalt or hot asphalt shall conform to type C of ASTM D 449. Hot asphalt shall be applied at a temperature of less than 200 °F.
- All joints in membrane waterproofing shall be lapped and sealed with an adhesive compatible with the membrane.
- 145) R406.4.1. Precast concrete foundation panel joints shall be sealed full height with a sealant meeting ASTM C 920, Type S or M, Grade NS, Class 25, Use NT, M or A. Joint sealant shall be installed in accordance with the manufacturer's installation instructions.
- 146) R407.1. Wood columns shall be protected against decay as set forth in Section R317.
- 147) R407.2. All surfaces (inside and outside) of steel columns shall be given a shop coat of rust-inhibitive paint, except for corrosion-resistant steel and steel treated with coatings to provide corrosion resistance.
- 148) R407.3. The columns shall be restrained to prevent lateral displacement at the bottom end. Wood columns shall not be less in nominal size than 4 inches by 4 inches. Steel columns shall not be less than 3-inch-diameter Schedule 40 pipe manufactured in accordance with ASTM A 53 Grade B or approved equivalent.
- Exception:** In Seismic Design Category B, columns no more than 48 inches in height on a pier or footing are exempt from the bottom end lateral displacement requirement within under-floor areas enclosed by a continuous foundation.

- 149) R408.1. The under-floor space between the bottom of the floor joists and the earth under any building (except space occupied by a basement) shall have ventilation openings through foundation walls or exterior walls. The minimum net area of ventilation openings shall not be less than 1 square foot for each 150 square feet of under-floor space area, unless the ground surface is covered by a Class 1 vapor retarder material. When a Class 1 vapor retarder material is used, the minimum net area of ventilation openings shall not be less than 1 square foot for each 1,500 square feet of under-floor space area. One such ventilating opening shall be within 3 feet of each corner of the building.
- 150) R408.2. The minimum net area of ventilation openings shall not be less than 1 square foot for each 150 square feet of under-floor area. One ventilation opening shall be within 3 feet of each corner of the building. Ventilation openings shall be covered for their height and width with any of the following materials provided that the least dimension of the covering shall not exceed  $\frac{1}{4}$  inch:
1. Perforated sheet metal plates not less than 0.070 inch thick.
  2. Expanded sheet metal plates not less than 0.047 inch thick.
  3. Cast-iron grill or grating.
  4. Extruded load-bearing brick vents.
  5. Hardware cloth of 0.035 inch wire or heavier.
  6. Corrosion-resistant wire mesh, with the least dimension being  $\frac{1}{8}$  inch thick.
- Exception:** The total area of ventilation openings shall be permitted to be reduced to  $\frac{1}{1,500}$  of the under-floor area where the ground surface is covered with an approved Class I vapor retarder material and the required openings are placed to provide cross ventilation of the space. The installation of operable louvers shall not be prohibited.
- 151) R408.3. Ventilation openings in under-floor spaces specified in Sections R408.1 and R408.2 shall not be required where:
1. Exposed earth is covered with a continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches and shall be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached and sealed to the stem wall; and
  2. One of the following is provided for the under-floor space:
    - 2.1. Continuously operated mechanical exhaust ventilation at a rate equal to 1 cubic foot per minute for each 50 square feet of crawlspace floor area, including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.9;
    - 2.2. Conditioned air supply sized to deliver at a rate equal to 1 cubic foot per minute for each 50 square feet of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section N1102.2.9;
    - 2.3. Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.
- 152) R408.4. Access shall be provided to all under-floor spaces. Access openings through the floor shall be a minimum of 18 inches by 24 inches. Openings through a perimeter wall shall be not less than 16 inches by 24 inches. When any portion of the through-wall access is below grade, an areaway not less than 16 inches by 24 inches shall be provided. The bottom of the areaway shall be below the threshold of the access opening. Through wall access openings shall not be located under a door to the residence. See Section M1305.1.4 for access requirements where mechanical equipment is located under floors.
- 153) R408.5. The under-floor grade shall be cleaned of all vegetation and organic material. All wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose. All construction materials shall be removed before a building is occupied or used for any purpose.
- 154) R408.6. The finished grade of under-floor surface may be located at the bottom of the footings; however, where there is evidence that the groundwater table can rise to within 6 inches of the finished floor at the building perimeter or where there is evidence that the surface water does not readily drain from the building site, the grade in the under-floor space shall be as high as the outside finished grade, unless an approved drainage system is provided.
- 155) R502.2.1. A load path for lateral forces shall be provided between floor framing and braced wall panels located above or below a floor, as specified in Section R602.10.6.

- 156) R502.2.2. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads as applicable. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal. Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting. For decks with cantilevered framing members, connections to exterior walls or other framing members, shall be designed and constructed to resist uplift resulting from the full live load specified in Table R301.5 acting on the cantilevered portion of the deck.
- 157) R502.2.2.1. For decks supporting a total design load of 50 pounds per square foot [40 pounds per square foot live load plus 10 pounds per square foot dead load], the connection between a deck ledger of pressure-preservative-treated Southern Pine, incised pressure-preservative-treated Hem-Fir or approved decay-resistant species, and a 2-inch nominal lumber band joist bearing on a sill plate or wall plate shall be constructed with  $\frac{1}{2}$ -inch lag screws or bolts with washers in accordance with Table R502.2.2.1. Lag screws, bolts and washers shall be hot-dipped galvanized or stainless steel.
- 158) R502.2.2.1.1. The lag screws or bolts shall be placed 2 inches in from the bottom or top of the deck ledgers and between 2 and 5 inches in from the ends. The lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger.
- 159) R502.2.2.2. Deck ledger connections not conforming to Table R502.2.2.1 shall be designed in accordance with accepted engineering practice. Girders supporting deck joists shall not be supported on deck ledgers or band joists. Deck ledgers shall not be supported on stone or masonry veneer.
- 160) R502.2.2.3. The lateral load connection required by Section R502.2.2 shall be permitted to be in accordance with Figure R502.2.2.3. Hold-down tension devices shall be installed in not less than two locations per deck, and each device shall have an allowable stress design capacity of not less than 1500 pounds.
- 161) R502.2.2.4. Wood/plastic composite deck boards shall be installed in accordance with the manufacturer's instructions.
- 162) R502.3. Spans for floor joists shall be in accordance with Tables R502.3.1(1) and R502.3.1(2). For other grades and species and for other loading conditions, refer to the AF&PA Span Tables for Joists and Rafters.
- 163) R502.3.3 Floor cantilevers. Floor cantilever spans shall not exceed the nominal depth of the wood floor joist. Floor cantilevers constructed in accordance with Table R502.3.3(1) shall be permitted when supporting a light-frame bearing wall and roof only. Floor cantilevers supporting an exterior balcony are permitted to be constructed in accordance with Table R502.3.3(2).
- 164) R502.4. Joists under parallel bearing partitions shall be of adequate size to support the load. Double joists, sized to adequately support the load, that are separated to permit the installation of piping or vents shall be full depth solid blocked with lumber not less than 2 inches in nominal thickness spaced not more than 4 feet on center. Bearing partitions perpendicular to joists shall not be offset from supporting girders, walls or partitions more than the joist depth unless such joists are of sufficient size to carry the additional load.
- 165) R502.5. The allowable spans of girders fabricated of dimension lumber shall not exceed the values set forth in Tables R502.5(1) and R502.5(2).
- 166) R502.6. The ends of each joist, beam or girder shall have not less than 1.5 inches of bearing on wood or metal and not less than 3 inches on masonry or concrete except where supported on a 1-inch-by-4-inch ribbon strip and nailed to the adjacent stud or by the use of approved joist hangers.
- 167) R502.6.1. Joists framing from opposite sides over a bearing support shall lap a minimum of 3 inches and shall be nailed together with a minimum three 10d face nails. A wood or metal splice with strength equal to or greater than that provided by the nailed lap is permitted.

- 168) R502.6.2. Joists framing into the side of a wood girder shall be supported by approved framing anchors or on ledger strips not less than nominal 2 inches by 2 inches.
- 169) R502.7. Joists shall be supported laterally at the ends by full-depth solid blocking not less than 2 inches nominal in thickness; or by attachment to a full-depth header, band or rim joist, or to an adjoining stud or shall be otherwise provided with lateral support to prevent rotation.
- Exceptions:**
1. Trusses, structural composite lumber, structural glued-laminated members and I-joists shall be supported laterally as required by the manufacturer's recommendations.
- 170) R502.7.1. Joists exceeding a nominal 2 inches by 12 inches shall be supported laterally by solid blocking, diagonal bridging (wood or metal), or a continuous 1-inch-by-3-inch strip nailed across the bottom of joists perpendicular to joists at intervals not exceeding 8 feet.
- Exception:** Trusses, structural composite lumber, structural glued-laminated members and I-joists shall be supported laterally as required by the manufacturer's recommendations.
- 171) R502.8.1. Notches in solid lumber joists, rafters and beams shall not exceed one-sixth of the depth of the member, shall not be longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Notches at the ends of the member shall not exceed one-fourth the depth of the member. The tension side of members 4 inches or greater in nominal thickness shall not be notched except at the ends of the members. The diameter of holes bored or cut into members shall not exceed one-third the depth of the member. Holes shall not be closer than 2 inches to the top or bottom of the member, or to any other hole located in the member. Where the member is also notched, the hole shall not be closer than 2 inches to the notch.
- 172) R502.8.2. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members or I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a registered design professional.
- 173) R502.9. Floor framing shall be nailed in accordance with Table R602.3(1). Where posts and beam or girder construction is used to support floor framing, positive connections shall be provided to ensure against uplift and lateral displacement.
- 174) R502.10. Openings in floor framing shall be framed with a header and trimmer joists. When the header joist span does not exceed 4 feet, the header joist may be a single member the same size as the floor joist. Single trimmer joists may be used to carry a single header joist that is located within 3 feet of the trimmer joist bearing. When the header joist span exceeds 4 feet, the trimmer joists and the header joist shall be doubled and of sufficient cross section to support the floor joists framing into the header. Approved hangers shall be used for the header joist to trimmer joist connections when the header joist span exceeds 6 feet. Tail joists over 12 feet long shall be supported at the header by framing anchors or on ledger strips not less than 2 inches by 2 inches.
- 175) R502.11.1. Wood trusses shall be designed in accordance with approved engineering practice. The design and manufacture of metal plate connected wood trusses shall comply with ANSI/TPI 1. The truss design drawings shall be prepared by a registered professional where required by the statutes of the jurisdiction in which the project is to be constructed in accordance with Section R106.1.
- 176) R502.11.2. Trusses shall be braced to prevent rotation and provide lateral stability in accordance with the requirements specified in the construction documents for the building and on the individual truss design drawings. In the absence of specific bracing requirements, trusses shall be braced in accordance with the Building Component Safety Information (BCSI 1-03) Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses.
- 177) R502.11.3. Truss members and components shall not be cut, notched, spliced or otherwise altered in any way without the approval of a registered design professional. Alterations resulting in the addition of load (e.g., HVAC

equipment, water heater, etc.), that exceed the design load for the truss, shall not be permitted without verification that the truss is capable of supporting the additional loading.

- 178) R502.11.4 Truss design drawings. Truss design drawings, prepared in compliance with Section R502.11.1, shall be submitted to the building official and approved prior to installation. Truss design drawings shall be provided with the shipment of trusses delivered to the job site.
- 179) R506.1. Concrete slab-on-ground floors shall be a minimum 3.5 inches thick (for expansive soils, see Section R403.1.8). The specified compressive strength of concrete shall be as set forth in Section R402.2.
- 180) R506.2. The area within the foundation walls shall have all vegetation, top soil and foreign material removed.
- 181) R506.2.1. Fill material shall be free of vegetation and foreign material. The fill shall be compacted to assure uniform support of the slab, and except where approved, the fill depths shall not exceed 24 inches for clean sand or gravel and 8 inches for earth.
- 182) R506.2.2. A 4-inch-thick base course consisting of clean graded sand, gravel, crushed stone or crushed blast-furnace slag passing a 2-inch sieve shall be placed on the prepared subgrade when the slab is below grade.
- 183) R506.2.3. (Amended). A 6 mil polyethylene or approved vapor retarder with joints lapped not less than 6 inches shall be placed between the concrete floor slab and the base course or the prepared subgrade where no base course exists.  
**Exception:** The vapor retarder may be omitted:  
1. From detached garages, utility buildings and other unheated accessory structures.  
2. From driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date.
- 184) R506.2.4. Where provided in slabs on ground, reinforcement shall be supported to remain in place from the center to upper one third of the slab for the duration of the concrete placement.
- 185) R601.2. Wall construction shall be capable of accommodating all loads imposed according to Section R301 and of transmitting the resulting loads to the supporting structural elements.
- 186) R602.2. Studs shall be a minimum No. 3, standard or stud grade lumber.  
**Exception:** Bearing studs not supporting floors and nonbearing studs may be utility grade lumber, provided the studs are spaced in accordance with Table R602.3(5).
- 187) R602.3. Exterior walls of wood-frame construction shall be designed and constructed in accordance with the provisions of this chapter and Figures R602.3(1) and R602.3(2) or in accordance with AF&PA's NDS. Components of exterior walls shall be fastened in accordance with Tables R602.3(1) through R602.3(4). Structural wall sheathing shall be fastened directly to structural framing members. Exterior wall coverings shall be capable of resisting the wind pressures listed in Table R301.2(2) adjusted for height and exposure using Table R301.2(3). Wood structural panel sheathing used for exterior walls shall conform to the requirements of Table R602.3(3).  
Studs shall be continuous from support at the sole plate to a support at the top plate to resist loads perpendicular to the wall. The support shall be a foundation or floor, ceiling or roof diaphragm or shall be designed in accordance with accepted engineering practice.  
**Exception:** Jack studs, trimmer studs and cripple studs at openings in walls that comply with Tables R502.5(1) and R502.5(2).
- 188) TABLE R602.3(1)  
FASTENER SCHEDULE FOR STRUCTURAL MEMBERS.
- 189) TABLE R602.3(5)  
SIZE, HEIGHT AND SPACING OF WOOD STUDS.

190) R602.3.1. The size, height and spacing of studs shall be in accordance with Table R602.3.(5).

**Exceptions:**

1. Utility grade studs shall not be spaced more than 16 inches on center, shall not support more than a roof and ceiling, and shall not exceed 8 feet in height for exterior walls and load-bearing walls or 10 feet for interior nonload-bearing walls.

2. Studs more than 10 feet in height which are in accordance with Table R602.3.1.

191) R602.3.2 Top plate. Wood stud walls shall be capped with a double top plate installed to provide overlapping at corners and intersections with bearing partitions. End joints in top plates shall be offset at least 24 inches. Joints in plates need not occur over studs. Plates shall be not less than 2-inches nominal thickness and have a width at least equal to the width of the studs.

**Exception:** A single top plate may be installed in stud walls, provided the plate is adequately tied at joints, corners and intersecting walls by a minimum 3-inch-by- 6-inch by a 0.036-inch-thick galvanized steel plate that is nailed to each wall or segment of wall by six 8d nails on each side, provided the rafters or joists are centered over the studs with a tolerance of no more than 1 inch. The top plate may be omitted over lintels that are adequately tied to adjacent wall sections with steel plates or equivalent as previously described.

192) R602.3.3. Where joists, trusses or rafters are spaced more than 16 inches on center and the bearing studs below are spaced 24 inches on center, such members shall bear within 5 inches of the studs beneath.

**Exceptions:**

1. The top plates are two 2-inch by 6-inch or two 3-inch by 4-inch members.

2. A third top plate is installed.

3. Solid blocking equal in size to the studs is installed to reinforce the double top plate.

193) R602.3.4 Bottom (sole) plate. Studs shall have full bearing on a nominal 2-by or larger plate or sill having a width at least equal to the width of the studs.

194) R602.4 Interior load-bearing walls shall be constructed, framed and fireblocked as specified for exterior walls.

195) R602.5. Interior nonbearing walls shall be permitted to be constructed with 2-inch-by-3-inch studs spaced 24 inches on center or, when not part of a braced wall line, 2-inch-by-4-inch flat studs spaced at 16 inches on center. Interior nonbearing walls shall be capped with at least a single top plate. Interior nonbearing walls shall be fireblocked in accordance with Section R602.8.

196) R602.6. Drilling and notching of studs shall be in accordance with the following:

1. Notching. Any stud in an exterior wall or bearing partition may be cut or notched to a depth not exceeding 25 percent of its width. Studs in nonbearing partitions may be notched to a depth not to exceed 40 percent of a single stud width.

2. Drilling. Any stud may be bored or drilled, provided that the diameter of the resulting hole is no more than 60 percent of the stud width, the edge of the hole is no more than  $\frac{5}{8}$  inch to the edge of the stud, and the hole is not located in the same section as a cut or notch. Studs located in exterior walls or bearing partitions drilled over 40 percent and up to 60 percent shall also be doubled with no more than two successive doubled studs bored. See Figures R602.6(1) and R602.6(2).

**Exception:** Use of approved stud shoes is permitted when they are installed in accordance with the manufacturer's recommendations.

197) R602.6.1. When piping or ductwork is placed in or partly in an exterior wall or interior load-bearing wall, necessitating cutting, drilling or notching of the top plate by more than 50 percent of its width, a galvanized metal tie not less than 0.054 inch thick (16 ga) and 1½ inches wide shall be fastened across and to the plate at each side of the opening with not less than eight 10d (0.148 inch diameter) having a minimum length of 1½ inches at each side or equivalent. The metal tie must extend a minimum of 6 inches past the opening.

**Exception:** When the entire side of the wall with the notch or cut is covered by wood structural panel sheathing.

198) R602.7. For header spans see Tables R502.5(1) and R502.5(2).



- 199) R602.7.1. Wood structural panel box headers shall be constructed in accordance with Figure R602.7.2 and Table R602.7.2.
- 200) R602.7.2. Load-bearing headers are not required in interior or exterior nonbearing walls. A single flat 2-inch-by-4-inch member may be used as a header in interior or exterior nonbearing walls for openings up to 8 feet in width if the vertical distance to the parallel nailing surface above is not more than 24 inches. For such nonbearing headers, no cripples or blocking are required above the header.
- 201) R602.10. Buildings shall be braced in accordance with this section. Where a building, or portion thereof, does not comply with one or more of the bracing requirements in this section, those portions shall be designed and constructed in accordance with Section R301.1.
- 202) R602.10.1. Braced wall lines shall be provided in accordance with this section. The length of a braced wall line shall be measured as the distance between the ends of the wall line. The end of a braced wall line shall be considered to be either:
1. The intersection with perpendicular exterior walls or projection thereof,
  2. The intersection with perpendicular braced wall lines.
- The end of the braced wall line shall be chosen such that the maximum length results.
- 203) R602.10.1.1. Braced wall panels shall be constructed in accordance with the intermittent bracing methods specified in Section R602.10.2, or the continuous sheathing methods specified in Sections R602.10.4 and R602.10.5. Mixing of bracing method shall be permitted as follows:
1. Mixing bracing methods from story to story is permitted.
  2. Mixing bracing methods from braced wall line to braced wall line within a story is permitted, except that continuous sheathing methods shall conform to the additional requirements of Sections R602.10.4 and R602.10.5.
  3. Mixing bracing methods within a braced wall line is permitted in Seismic Design Category B. The length of required bracing for the braced wall line with mixed sheathing types shall have the higher bracing length requirement, in accordance with Tables R602.10.1.2(1) and R602.10.1.2(2), of all types of bracing used.
- 204) R602.10.1.2. The length of bracing along each braced wall line shall be the greater of that required by the design wind speed and braced wall line spacing in accordance with Table R602.10.1.2(1) as adjusted by the factors in the footnotes or the Seismic Design Category and braced wall line length in accordance with Table R602.10.1.2(2) as adjusted by the factors in Table R602.10.1.2(3) or braced wall panel location requirements of Section R602.10.1.4. Only walls that are parallel to the braced wall line shall be counted toward the bracing requirement of that line, except angled walls shall be counted in accordance with Section R602.10.1.3. In no case shall the minimum total length of bracing in a braced wall line, after all adjustments have been taken, be less than 48 inches total.
- 205) R602.10.1.2.1 Braced wall panel uplift load path. Braced wall panels located at exterior walls that support roof rafters or trusses (including stories below top story) shall have the framing members connected in accordance with one of the following:
1. Fastening in accordance with Table R602.3(1) where:
    - 1.1. The basic wind speed does not exceed 90 mph, the wind exposure category is B, the roof pitch is 5:12 or greater, and the roof span is 32 feet or less, or
    - 1.2. The net uplift value at the top of a wall does not exceed 100 plf. The net uplift value shall be determined in accordance with Section R802.11 and shall be permitted to be reduced by 60 plf for each full wall above.
  2. Where the net uplift value at the top of a wall exceeds 100 plf, installing approved uplift framing connectors to provide a continuous load path from the top of the wall to the foundation. The net uplift value shall be as determined in Item 1.2 above.
  3. Bracing and fasteners designed in accordance with accepted engineering practice to resist combined uplift and shear forces.
- 206) R602.10.1.4. Braced wall panels shall be located in accordance with Figure R602.10.1.4(1). Braced wall panels shall be located not more than 25 feet on center and shall be permitted to begin no more than 12.5 feet from the

end of a braced wall line in accordance with Section R602.10.1 and Figure R602.10.1.4(2). The total combined distance from each end of a braced wall line to the outermost braced wall panel or panels in the line shall not exceed 12.5 feet. Braced wall panels may be offset out-of-plane up to 4 feet from the designated braced wall line provided that the total out-to-out offset of braced wall panels in a braced wall line is not more than 8 feet in accordance with Figures R602.10.1.4(3) and R602.10.1.4(4). All braced wall panels within a braced wall line shall be permitted to be offset from the designated braced wall line.

- 207) R602.10.3.2 Method ABW: Alternate braced wall panels. Method ABW braced wall panels constructed in accordance with one of the following provisions shall be permitted to replace each 4 feet of braced wall panel as required by Section R602.10.3. The maximum height and minimum length and hold-down force of each panel shall be in accordance with Table R602.10.3.2:
1. In one-story buildings, each panel shall be installed in accordance with Figure R602.10.3.2. The hold-down device shall be installed in accordance with the manufacturer's recommendations. The panels shall be supported directly on a foundation or on floor framing supported directly on a foundation which is continuous across the entire length of the braced wall line.
  2. In the first story of two-story buildings, each braced wall panel shall be in accordance with Item 1 above, except that the wood structural panel sheathing edge nailing spacing shall not exceed 4 inches on center.
- 208) R602.10.3.3 Method PFH: Portal frame with hold-downs. Method PFH braced wall panels constructed in accordance with one of the following provisions are also permitted to replace each 4 feet of braced wall panel as required by Section R602.10.3 for use adjacent to a window or door opening with a full-length header:
1. Each panel shall be fabricated in accordance with Figure R602.10.3.3. The wood structural panel sheathing shall extend up over the solid sawn or glued-laminated header and shall be nailed in accordance with Figure R602.10.3.3. A spacer, if used with a built-up header, shall be placed on the side of the built-up beam opposite the wood structural panel sheathing. The header shall extend between the inside faces of the first full-length outer studs of each panel. One anchor bolt not less than  $\frac{5}{8}$ -inch-diameter and installed in accordance with Section R403.1.6 shall be provided in the center of each sill plate. The hold-down devices shall be an embedded-strap type, installed in accordance with the manufacturer's recommendations. The panels shall be supported directly on a foundation which is continuous across the entire length of the braced wall line. The foundation shall be reinforced as shown on Figure R602.10.3.2. This reinforcement shall be lapped not less than 15 inches with the reinforcement required in the continuous foundation located directly under the braced wall line.
  2. In the first story of two-story buildings, each wall panel shall be braced in accordance with item 1 above, except that each panel shall have a length of not less than 24 inches.
- 209) R602.10.3.4 Method PFG: at garage door openings in Seismic Design Category B. Where supporting a roof or one story and a roof, alternate braced wall panels constructed in accordance with the following provisions are permitted on either side of garage door openings. For the purpose of calculating wall bracing amounts to satisfy the minimum requirements of Table R602.10.1.2(1), the length of the alternate braced wall panel shall be multiplied by a factor of 1.5.
1. Braced wall panel length shall be a minimum of 24 inches and braced wall panel height shall be a maximum of 10 feet.
  2. Braced wall panel shall be sheathed on one face with a single layer of  $\frac{7}{16}$ -inch-minimum thickness wood structural panel sheathing attached to framing with 8d common nails at 3 inches on center in accordance with Figure R602.10.3.4.
  3. The wood structural panel sheathing shall extend up over the solid sawn or glued-laminated header and shall be nailed to the header at 3 inches on center grid in accordance with Figure R602.10.3.4.
  4. The header shall consist of a minimum of two solid sawn 2×12s or a 3 inches × 11.25 inch glued-laminated header. The header shall extend between the inside faces of the first full-length outer studs of each panel in accordance with Figure R602.10.3.4. The clear span of the header between the inner studs of each panel shall be not less than 6 feet and not more than 18 feet in length.
  5. A strap with an uplift capacity of not less than 1,000 pounds shall fasten the header to the side of the inner studs opposite the sheathing face. Where building is located in Wind Exposure Categories C or D, the strap uplift capacity shall be in accordance with Table R602.10.4.1.1.

6. A minimum of two bolts not less than  $\frac{1}{2}$ -inch diameter shall be installed in accordance with Section R403.1.6. A  $\frac{3}{16}$ -inch by  $2\frac{1}{2}$ -inch by  $2\frac{1}{2}$ -inch steel plate washer is installed between the bottom plate and the nut of each bolt.

7. Braced wall panel shall be installed directly on a foundation.

8. Where an alternate braced wall panel is located only on one side of the garage opening, the header shall be connected to a supporting jack stud on the opposite side of the garage opening with a metal strap with an uplift capacity of not less than 1,000 pounds. Where that supporting jack stud is not part of a braced wall panel assembly, another 1,000 pounds strap shall be installed to attach the supporting jack stud to the foundation.

- 210) R602.10.4. Braced wall lines with continuous sheathing shall be constructed in accordance with this section. All braced wall lines along exterior walls on the same story shall be continuously sheathed.

**Exception:** Within Seismic Design Category B or in regions where the basic wind speed is less than or equal to 100 mph, other bracing methods prescribed by this code shall be permitted on other braced wall lines on the same story level or on any braced wall line on different story levels of the building.

- 211) R602.10.4.1. Continuous sheathing methods require structural panel sheathing to be used on all sheathable surfaces on one side of a braced wall line including areas above and below openings and gable end walls. Braced wall panels shall be constructed in accordance with one of the methods listed in Table R602.10.4.1. Different bracing methods, other than those listed in Table R602.10.4.1, shall not be permitted along a braced wall line with continuous sheathing.

- 212) R602.10.4.1.1. Continuous portal frame braced wall panels shall be constructed in accordance with Figure R602.10.4.1.1. The number of continuous portal frame panels in a single braced wall line shall not exceed four. For purposes of resisting wind pressures acting perpendicular to the wall, the requirements of Figure R602.10.4.1.1 and Table R602.10.4.1.1 shall be met. There shall be a maximum of two braced wall segments per header and header length shall not exceed 22 feet. Tension straps shall be installed in accordance with the manufacturer's recommendations.

- 213) R602.10.4.2. Braced wall panels along a braced wall line with continuous sheathing shall be full-height with a length based on the adjacent clear opening height in accordance with Table R602.10.4.2 and Figure R602.10.4.2. Within a braced wall line when a panel has an opening on either side of differing heights, the taller opening height shall be used to determine the panel length from Table R602.10.4.2. For Method CS-PF, wall height shall be measured from the top of the header to the bottom of the bottom plate as shown in Figure R602.10.4.1.1.

- 214) R602.10.4.3. Braced wall lines with continuous sheathing shall be provided with braced wall panels in the length required in Tables R602.10.1.2(1) and R602.10.1.2(2). Only those full-height braced wall panels complying with the length requirements of Table R602.10.4.2 shall be permitted to contribute to the minimum required length of bracing.

- 215) R602.10.4.4. For all continuous sheathing methods, full-height braced wall panels complying with the length requirements of Table R602.10.4.2 shall be located at each end of a braced wall line with continuous sheathing and at least every 25 feet on center. A minimum 24 inch wood structural panel corner return shall be provided at both ends of a braced wall line with continuous sheathing in accordance with Figures R602.10.4.4(1) and R602.10.4.4(2). In lieu of the corner return, a hold-down device with a minimum uplift design value of 800 pounds shall be fastened to the corner stud and to the foundation or framing below in accordance with Figure R602.10.4.4(3).

**Exception:** The first braced wall panel shall be permitted to begin 12.5 feet from each end of the braced wall line in Seismic Design Category B provided one of the following is satisfied:

1. A minimum 24 inch long, full-height wood structural panel is provided at both sides of a corner constructed in accordance with Figure R602.10.4.4(1) at the braced wall line ends in accordance with Figure R602.10.4.4(4), or
2. The braced wall panel closest to the corner shall have a hold-down device with a minimum uplift design value of 800 pounds fastened to the stud at the edge of the braced wall panel closest to the corner and to the foundation or framing below in accordance with Figure R602.10.4.4(5).

- 216) R602.10.5 Continuously-sheathed braced wall line using Method CS-SFB (structural fiberboard sheathing). Continuously sheathed braced wall lines using structural fiberboard sheathing shall comply with this section. Different bracing methods shall not be permitted within a continuously sheathed braced wall line. Other bracing methods prescribed by this code shall be permitted on other braced wall lines on the same story level or on different story levels of the building.
- 217) R602.10.5.1. Continuously-sheathed braced wall lines shall be in accordance with Figure R602.10.4.2 and shall comply with all of the following requirements:
1. Structural fiberboard sheathing shall be applied to all exterior sheathable surfaces of a braced wall line including areas above and below openings.
  2. Only full-height or blocked braced wall panels shall be used for calculating the braced wall length in accordance with Tables R602.10.1.2(1) and R602.10.1.2(2).
- 218) R602.10.5.2. In a continuously-sheathed structural fiberboard braced wall line, the minimum braced wall panel length shall be in accordance with Table R602.10.5.2.
- 219) R602.10.5.3. A braced wall panel shall be located at each end of a continuously-sheathed braced wall line. A minimum 32-inch structural fiberboard sheathing panel corner return shall be provided at both ends of a continuously-sheathed braced wall line in accordance with Figure R602.10.4.4(1). In lieu of the corner return, a hold-down device with a minimum uplift design value of 800 pounds shall be fastened to the corner stud and to the foundation or framing below in accordance with Figure R602.10.4.4(3).
- Exception:** The first braced wall panel shall be permitted to begin 12 feet 6 inches from each end of the braced wall line in Seismic Design Category B provided one of the following is satisfied:
1. A minimum 32-inch-long full-height structural fiberboard sheathing panel is provided at both sides of a corner constructed in accordance with Figure R602.10.4.4(1) at the braced wall line ends in accordance with Figure R602.10.4.4(4), or
  2. The braced wall panel closest to the corner shall have a hold-down device with a minimum uplift design value of 800 pounds fastened to the stud at the edge of the braced wall panel closest to the corner and to the foundation or framing below in accordance with Figure R602.10.4.4(5).
- 220) R602.10.6. Braced wall panels shall be connected to floor framing or foundations as follows:
1. Where joists are perpendicular to a braced wall panel above or below, a rim joist, band joist or blocking shall be provided along the entire length of the braced wall panel in accordance with Figure R602.10.6(1). Fastening of top and bottom wall plates to framing, rim joist, band joist and/or blocking shall be in accordance with Table R602.3(1).
  2. Where joists are parallel to a braced wall panel above or below, a rim joist, end joist or other parallel framing member shall be provided directly above and below the braced wall panel in accordance with Figure R602.10.6(2). Where a parallel framing member cannot be located directly above and below the panel, full-depth blocking at 16 inch spacing shall be provided between the parallel framing members to each side of the braced wall panel in accordance with Figure R602.10.6(2). Fastening of blocking and wall plates shall be in accordance with Table R602.3(1) and Figure R602.10.6(2).
  3. Connections of braced wall panels to concrete or masonry shall be in accordance with Section R403.1.6.
- 221) R602.10.6.2. Exterior braced wall panels shall be connected to roof framing as follows.
1. Parallel rafters or roof trusses shall be attached to the top plates of braced wall panels in accordance with Table R602.3(1).
  2. For SDC B and wind speeds less than 100 miles per hour, where the distance from the top of the rafters or roof trusses and perpendicular top plates is  $9\frac{1}{4}$  inches or less, the rafters or roof trusses shall be connected to the top plates of braced wall lines in accordance with Table R602.3(1) and blocking need not be installed. Where the distance from the top of the rafters and perpendicular top plates is between  $9\frac{1}{4}$  inches and  $15\frac{1}{4}$  inches the rafters shall be connected to the top plates of braced wall panels with blocking in accordance with Figure R602.10.6.2(1) and attached in accordance with Table R602.3(1). Where the distance from the top of the roof trusses and perpendicular top plates is between  $9\frac{1}{4}$  inches and  $15\frac{1}{4}$  inches the roof trusses shall be connected to the top plates of braced wall panels with blocking in accordance with Table R602.3(1).
  3. Not applicable to our SDC.

4. For all seismic design categories and wind speeds, where the distance between the top of rafters or roof trusses and perpendicular top plates exceeds  $15\frac{1}{4}$  inches, perpendicular rafters or roof trusses shall be connected to the top plates of braced wall panels in accordance with one of the following methods:

- 4.1. In accordance with Figure R602.10.6.2(2),
- 4.2. In accordance with Figure R602.10.6.2(3),
- 4.3. With full height engineered blocking panels designed for values listed in American Forest and Paper Association (AF&PA) Wood Frame Construction Manual for One- and Two-Family Dwellings (WFCM). Both the roof and floor sheathing shall be attached to the blocking panels in accordance with Table R602.3(1).
- 4.4. Designed in accordance with accepted engineering methods.

Lateral support for the rafters and ceiling joists shall be provided in accordance with Section R802.8. Lateral support for trusses shall be provided in accordance with Section R802.10.3. Ventilation shall be provided in accordance with Section R806.1.

- 222) R602.10.7. Braced wall panel support shall be provided as follows:
1. Cantilevered floor joists, supporting braced wall lines, shall comply with Section R502.3.3. Solid blocking shall be provided at the nearest bearing wall location. In Seismic Design Category B, where the cantilever is not more than 24 inches, a full height rim joist instead of solid blocking shall be provided.
  2. Elevated post or pier foundations supporting braced wall panels shall be designed in accordance with accepted engineering practice.
  3. Masonry stem walls with a length of 48 inches or less supporting braced wall panels shall be reinforced in accordance with Figure R602.10.7. Masonry stem walls with a length greater than 48 inches supporting braced wall panels shall be constructed in accordance with Section R403.1. Braced wall panels constructed in accordance with Sections R602.10.3.2 and R602.10.3.3 shall not be attached to masonry stem walls.
- 223) R602.12. Where stone and masonry veneer is installed in accordance with Section R703.7 wall bracing shall comply with this section. For all buildings in Seismic Design Category B, wall bracing at exterior and interior braced wall lines shall be in accordance with Section R602.10 and the additional requirements of Table R602.12(1).
- 224) R606.1. Masonry construction shall be designed and constructed in accordance with the provisions of this section or in accordance with the provisions of ACI 530/ASCE 5/TMS 402.
- 225) R606.2.1. The minimum thickness of masonry bearing walls more than one story high shall be 8 inches. Solid masonry walls of one-story dwellings and garages shall not be less than 6 inches in thickness when not greater than 9 feet in height, provided that when gable construction is used, an additional 6 feet is permitted to the peak of the gable. Masonry walls shall be laterally supported in either the horizontal or vertical direction at intervals as required by Section R606.9.
- 226) R606.3. Corbeled masonry shall be in accordance with Sections R606.3.1 through R606.3.3.
- 227) R606.3.1. Solid masonry units or masonry units filled with mortar or grout shall be used for corbeling.
- 228) R606.3.2. The maximum projection of one unit shall not exceed one-half the height of the unit or one-third the thickness at right angles to the wall. The maximum corbeled projection beyond the face of the wall shall not exceed:
1. One-half of the wall thickness for multiwythe walls bonded by mortar or grout and wall ties or masonry headers, or
  2. One-half the wythe thickness for single wythe walls, masonry-bonded hollow walls, multiwythe walls with open collar joints and veneer walls.
- 229) R606.3.3 Corbeled masonry supporting floor or roof-framing members. When corbeled masonry is used to support floor or roof-framing members, the top course of the corbel shall be a header course or the top course bed joint shall have ties to the vertical wall.

- 230) R606.4.2. Cavity wall or masonry veneer construction may be supported on an 8-inch foundation wall, provided the 8-inch wall is corbeled to the width of the wall system above with masonry constructed of solid masonry units or masonry units filled with mortar or grout. The total horizontal projection of the corbel shall not exceed 2 inches with individual corbels projecting not more than one-third the thickness of the unit or one-half the height of the unit. The hollow space behind the corbeled masonry shall be filled with mortar or grout.
- 231) R606.9.2. Vertical lateral support of masonry walls in Seismic Design Category B shall be provided in accordance with one of the methods in Section R606.9.2.1 or Section R606.9.2.2.
- 232) R606.13. Bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall not have less than  $\frac{5}{8}$ -inch mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one bar diameter over all bars, but not less than  $\frac{3}{4}$  inch, except where exposed to weather or soil, in which case the minimum coverage shall be 2 inches.
- 233) R606.14 Beam supports. Beams, girders or other concentrated loads supported by a wall or column shall have a bearing of at least 3 inches in length measured parallel to the beam upon solid masonry not less than 4 inches in thickness, or upon a metal bearing plate of adequate design and dimensions to distribute the load safely, or upon a continuous reinforced masonry member projecting not less than 4 inches from the face of the wall.
- 234) R606.14.1. Joists shall have a bearing of not less than  $1\frac{1}{2}$  inches, except as provided in Section R606.14, and shall be supported in accordance with Figure R606.11(1).
- 235) R607.1.1. Masonry foundation walls constructed as set forth in Tables R404.1.1(1) through R404.1.1(4) and mortar shall be Type M or S.
- 236) R607.1.2. Mortar for masonry serving as the lateral-force-resisting system in Seismic Design Category B shall be Type M, S or N mortar.
- 237) R607.3. The installation of wall ties shall be as follows:
1. The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least  $\frac{1}{2}$  inch. Wire wall ties shall be embedded at least  $1\frac{1}{2}$  inches into the mortar bed of solid masonry units or solid grouted hollow units.
  2. Wall ties shall not be bent after being embedded in grout or mortar.
- 238) R612.1. This section prescribes performance and construction requirements for exterior window and door installed in wall. Windows and doors shall be installed and flashed in accordance with the fenestration manufacturer's written installation instructions. Window and door openings shall be flashed in accordance with Section R703.8. Written installation instructions shall be provided by the fenestration manufacturer for each window or door.
- 239) R612.2 (Amended). In dwelling units, where the opening of an operable window is located more than 72 inches above the finished grade or surface below, the lowest part of the clear opening of the window shall be a minimum of 18 inches above the finished floor of the room in which the window is located. Operable sections of windows shall not permit openings that allow passage of a 4 inch diameter sphere where such openings are located within 24 inches of the finished floor.
- Exceptions:**
1. Windows whose openings will not allow a 4-inch- diameter sphere to pass through the opening when the opening is in its largest opened position.
  2. Openings that are provided with window fall prevention devices that comply with Section R612.3.
  3. Openings that are provided with fall prevention devices that comply with ASTM F 2090.
  4. Windows that are provided with opening limiting devices that comply with Section R612.4.
- 240) R612.3. Window fall prevention devices and window guards, where provided, shall comply with the requirements of ASTM F 2090.

- 241) R612.4.1. Window opening limiting devices shall be self acting and shall be positioned to prohibit the free passage of a 4-in. diameter rigid sphere through the window opening when the window opening limiting device is installed in accordance with the manufacturer's instructions.
- 242) R612.4.2. Window opening limiting devices shall be designed with release mechanisms to allow for emergency escape through the window opening without the need for keys, tools or special knowledge. Window opening limiting devices shall comply with all of the following:
1. Release of the window opening-limiting device shall require no more than 15 pounds of force.
  2. The window opening limiting device release mechanism shall operate properly in all types of weather.
  3. Window opening limiting devices shall have their release mechanisms clearly identified for proper use in an emergency.
  4. The window opening limiting device shall not reduce the minimum net clear opening area of the window unit below what is required by Section R310.1.1 of the code.
- 243) R612.9.1. Fenestration shall be tested by an approved independent laboratory, listed by an approved entity, and bear a label identifying manufacturer, performance characteristics, and approved inspection agency to indicate compliance with the requirements of the following specification:
1. ASTM E 1886 and ASTM E 1996; or
  2. AAMA 506.
- 244) R701.2. Products sensitive to adverse weather shall not be installed until adequate weather protection for the installation is provided. Exterior sheathing shall be dry before applying exterior cover.
- 245) R703.1. Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.8.
- 246) R703.1.1. The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R601.3 of this code.
- 247) R703.2. One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches. Where joints occur, felt shall be lapped not less than 6 inches. The felt or other approved material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1.
- Exception:** Omission of the water-resistive barrier is permitted in the following situations:
1. In detached accessory buildings.
  2. Under exterior wall finish materials as permitted in Table R703.4.
  3. Under paperbacked stucco lath when the paper backing is an approved water-resistive barrier.
- 248) R703.3.1. Joints in wood, hardboard or wood structural panel siding shall be made as follows unless otherwise approved. Vertical joints in panel siding shall occur over framing members, unless wood or wood structural panel sheathing is used, and shall be shiplapped or covered with a batten. Horizontal joints in panel siding shall be lapped a minimum of 1 inch or shall be shiplapped or shall be flashed with Z-flashing and occur over solid blocking, wood or wood structural panel sheathing.
- 249) R703.3.2. Horizontal lap siding shall be installed in accordance with the manufacturer's recommendations. Where there are no recommendations the siding shall be lapped a minimum of 1 inch, or  $\frac{1}{2}$  inch if rabbeted, and shall have the ends caulked, covered with a batten or sealed and installed over a strip of flashing.

- 250) R703.4. Unless specified otherwise, all wall coverings shall be securely fastened in accordance with Table R703.4 or with other approved aluminum, stainless steel, zinc-coated or other approved corrosion-resistive fasteners.
- 251) R703.5.1. Wood shakes or shingles shall be applied either single-course or double-course over nominal  $\frac{1}{2}$ -inch wood-based sheathing or to furring strips over  $\frac{1}{2}$ -inch nominal nonwood sheathing. A permeable water-resistive barrier shall be provided over all sheathing, with horizontal overlaps in the membrane of not less than 2 inches and vertical overlaps of not less than 6 inches. Where furring strips are used, they shall be 1 inch by 3 inches or 1 inch by 4 inches and shall be fastened horizontally to the studs with 7d or 8d box nails and shall be spaced a distance on center equal to the actual weather exposure of the shakes or shingles, not to exceed the maximum exposure specified in Table R703.5.2. The spacing between adjacent shingles to allow for expansion shall not exceed  $\frac{1}{4}$  inch, and between adjacent shakes, it shall not exceed  $\frac{1}{2}$  inch. The offset spacing between joints in adjacent courses shall be a minimum of  $\frac{1}{2}$  inches.
- 252) R703.5.3. Each shake or shingle shall be held in place by two hot-dipped zinc-coated, stainless steel, or aluminum nails or staples. The fasteners shall be long enough to penetrate the sheathing or furring strips by a minimum of  $\frac{1}{2}$  inch and shall not be overdriven. The bottom courses shall be doubled.
- 253) R703.7. Stone and masonry veneer shall be installed in accordance with this chapter, Table R703.4 and Figure R703.7. These veneers installed over a backing of wood or cold-formed steel shall be limited to the first story above-grade and shall not exceed 5 inches (127 mm) in thickness. See Section R602.12 for wall bracing requirements for masonry veneer for wood framed construction and Section R603.9.5 for wall bracing requirements for masonry veneer for cold-formed steel construction.
- Exceptions:**
1. For all buildings in Seismic Design Category B, exterior stone or masonry veneer, as specified in Table R703.7(1), with a backing of wood or steel framing shall be permitted to the height specified in Table R703.7(1) above a noncombustible foundation.
- 254) R703.7.1. Veneers used as interior wall finishes shall be permitted to be supported on wood or cold-formed steel floors that are designed to support the loads imposed.
- 255) R703.7.2. Exterior masonry veneers having an installed weight of 40 pounds per square foot or less shall be permitted to be supported on wood or cold-formed steel construction. When masonry veneer supported by wood or cold-formed steel construction adjoins masonry veneer supported by the foundation, there shall be a movement joint between the veneer supported by the wood or cold-formed steel construction and the veneer supported by the foundation. The wood or cold-formed steel construction supporting the masonry veneer shall be designed to limit the deflection to  $\frac{1}{600}$  of the span for the supporting members. The design of the wood or cold-formed steel construction shall consider the weight of the veneer and any other loads.
- 256) R703.7.2.1. A minimum 6 inches by 4 inches by  $\frac{5}{16}$  inch steel angle, with the long leg placed vertically, shall be anchored to double 2 inches by 4 inches wood studs at a maximum on-center spacing of 16 inches. Anchorage of the steel angle at every double stud spacing shall be a minimum of two  $\frac{7}{16}$  inch diameter by 4 inch lag screws. The steel angle shall have a minimum clearance to underlying construction of  $\frac{1}{16}$  inch. A minimum of two-thirds the width of the masonry veneer thickness shall bear on the steel angle. Flashing and weep holes shall be located in the masonry veneer wythe in accordance with Figure R703.7.2.1. The maximum height of masonry veneer above the steel angle support shall be 12 feet, 8 inches. The air space separating the masonry veneer from the wood backing shall be in accordance with Sections R703.7.4 and R703.7.4.2. The method of support for the masonry veneer on wood construction shall be constructed in accordance with Figure R703.7.2.1.
- 257) R703.7.2.2 Support by roof construction. A steel angle shall be placed directly on top of the roof construction. The roof supporting construction for the steel angle shall consist of a minimum of three 2-inch by 6-inch wood members. The wood member abutting the vertical wall stud construction shall be anchored with a minimum of three  $\frac{5}{8}$ -inch diameter by 5-inch lag screws to every wood stud spacing. Each additional roof member shall be anchored by the use of two 10d nails at every wood stud spacing. A minimum of two-thirds the width of the masonry veneer thickness shall bear on the steel angle. Flashing and weep holes shall be located in the masonry



veneer wythe in accordance with Figure R703.7.2.2. The maximum height of the masonry veneer above the steel angle support shall be 12 feet, 8 inches. The air space separating the masonry veneer from the wood backing shall be in accordance with Sections R703.7.4 and R703.7.4.2. The support for the masonry veneer on wood construction shall be constructed in accordance with Figure R703.7.2.2.

- 258) R703.7.3 Lintels. Masonry veneer shall not support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported on lintels of noncombustible materials. The lintels shall have a length of bearing not less than 4 inches. Steel lintels shall be shop coated with a rust-inhibitive paint, except for lintels made of corrosion-resistant steel or steel treated with coatings to provide corrosion resistance. Construction of openings shall comply with either Section R703.7.3.1 or 703.7.3.2.
- 259) R703.7.3.1 The allowable span shall not exceed the values set forth in Table R703.7.3.1.
- 260) R703.7.4. Masonry veneer shall be anchored to the supporting wall with corrosion-resistant metal ties embedded in mortar or grout and extending into the veneer a minimum of  $1\frac{1}{2}$  inches, with not less than  $\frac{5}{8}$  inch mortar or grout cover to outside face. Where veneer is anchored to wood backings by corrugated sheet metal ties, the distance separating the veneer from the sheathing material shall be a maximum of a nominal 1 inch. Where the veneer is anchored to wood backings using metal strand wire ties, the distance separating the veneer from the sheathing material shall be a maximum of  $4\frac{1}{2}$  inches.
- 261) R703.7.4.1.1 Veneer ties around wall openings. Veneer ties around wall openings. Additional metal ties shall be provided around all wall openings greater than 16 inches in either dimension. Metal ties around the perimeter of openings shall be spaced not more than 3 feet on center and placed within 12 inches of the wall opening.
- 262) R703.7.4.2. The veneer shall be separated from the sheathing by an air space of a minimum of a nominal 1 inch but not more than  $4\frac{1}{2}$  inches.
- 263) R703.7.4. 3. As an alternate to the air space required by Section R703.7.4.2, mortar or grout shall be permitted to fill the air space. When the air space is filled with mortar, a water-resistive barrier is required over studs or sheathing. When filling the air space, replacing the sheathing and water-resistive barrier with a wire mesh and approved water-resistive barrier or an approved water-resistive barrier-backed reinforcement attached directly to the studs is permitted.
- 264) R703.7.5. Flashing shall be located beneath the first course of masonry above finished ground level above the foundation wall or slab and at other points of support, including structural floors, shelf angles and lintels when masonry veneers are designed in accordance with Section R703.7. See Section R703.8 for additional requirements.
- 265) R703.7.6. Weepholes shall be provided in the outside wythe of masonry walls at a maximum spacing of 33 inches on center. Weepholes shall not be less than  $\frac{3}{16}$  inch in diameter. Weepholes shall be located immediately above the flashing.
- 266) R703.8. Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at all of the following locations:
1. Exterior window and door openings. Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage.
  2. At the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings.
  3. Under and at the ends of masonry, wood or metal copings and sills.
  4. Continuously above all projecting wood trim.
  5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction.
  6. At wall and roof intersections.
  7. At built-in gutters.

- 267) R703.9. Exterior Insulation and Finish System (EIFS) shall comply with this chapter and Sections R703.9.1 and R703.9.3. EIFS with drainage shall comply with this chapter and Sections R703.9.2, R703.9.3 and R703.9.4. EIFS shall comply with ASTM E 2568.
- 268) R703.9.2 Exterior insulation and finish system (EIFS) with drainage. EIFS with drainage shall comply with ASTM E 2568 and shall have an average minimum drainage efficiency of 90 percent when tested in accordance with ASTM E 2273.
- 269) R703.9.2.1. The water-resistive barrier shall comply with Section R703.2 or ASTM E 2570. The water-resistive barrier shall be applied between the EIFS and the wall sheathing.
- 270) R703.9.3. Flashing of EIFS shall be provided in accordance with the requirements of Section R703.8.
- 271) R703.9.4. All EIFS shall be installed in accordance with the manufacturer's installation instructions and the requirements of this section.
- 272) R703.9.4.1. The EIFS shall terminate not less than 6 inches above the finished ground level.
- 273) R703.9.4.2. Decorative trim shall not be face nailed though the EIFS.
- 274) R703.10.1. Fiber-cement panels shall comply with the requirements of ASTM C1186, Type A, minimum Grade II. Panels shall be installed with the long dimension either parallel or perpendicular to framing. Vertical and horizontal joints shall occur over framing members and shall be sealed with caulking, covered with battens or shall be designed to comply with Section R703.1. Panel siding shall be installed with fasteners according to Table R703.4 or approved manufacturer's installation instructions.
- 275) R703.10.2. Fiber-cement lap siding having a maximum width of 12 inches shall comply with the requirements of ASTM C1186, Type A, minimum Grade II. Lap siding shall be lapped a minimum of 1<sup>1</sup>/<sub>4</sub> inches and lap siding not having tongue-and-groove end joints shall have the ends sealed with caulking, installed with an H-section joint cover, located over a strip of flashing or shall be designed to comply with Section R703.1. Lap siding courses may be installed with the fastener heads exposed or concealed, according to Table R703.4 or approved manufacturers' installation instructions.
- 276) R703.11.1. Vinyl siding, soffit and accessories shall be installed in accordance with the manufacturer's installation instructions.
- 277) R703.11.1.1 Soffit panels shall be individually fastened to a supporting component such as a nailing strip, fascia or subfascia component or as specified by the manufacturer's instructions.
- 278) R703.12 Adhered masonry veneer installation. Adhered masonry veneer shall be installed in accordance with the manufacturer's instructions.
- 279) R802.3. Rafters shall be framed to ridge board or to each other with a gusset plate as a tie. Ridge board shall be at least 1-inch nominal thickness and not less in depth than the cut end of the rafter. At all valleys and hips there shall be a valley or hip rafter not less than 2-inch nominal thickness and not less in depth than the cut end of the rafter. Hip and valley rafters shall be supported at the ridge by a brace to a bearing partition or be designed to carry and distribute the specific load at that point. Where the roof pitch is less than three units vertical in 12 units horizontal (25-percent slope), structural members that support rafters and ceiling joists, such as ridge beams, hips and valleys, shall be designed as beams.
- 280) R802.3.1. Ceiling joists and rafters shall be nailed to each other in accordance with Table R802.5.1(9), and the rafter shall be nailed to the top wall plate in accordance with Table R602.3(1). Ceiling joists shall be continuous or securely joined in accordance with Table R802.5.1(9) where they meet over interior partitions and are nailed to adjacent rafters to provide a continuous tie across the building when such joists are parallel to the rafters. Where

ceiling joists are not connected to the rafters at the top wall plate, joists connected higher in the attic shall be installed as rafter ties, or rafter ties shall be installed to provide a continuous tie. Where ceiling joists are not parallel to rafters, rafter ties shall be installed. Rafter ties shall be a minimum of 2-inch by 4-inch (nominal), installed in accordance with the connection requirements in Table R802.5.1(9), or connections of equivalent capacities shall be provided. Where ceiling joists or rafter ties are not provided, the ridge formed by these rafters shall be supported by a wall or girder designed in accordance with accepted engineering practice. Collar ties shall be a minimum of 1-inch by 4-inch (nominal), spaced not more than 4 feet on center.

- 281) R802.3.2. Ends of ceiling joists shall be lapped a minimum of 3 inches or butted over bearing partitions or beams and toenailed to the bearing member. When ceiling joists are used to provide resistance to rafter thrust, lapped joists shall be nailed together in accordance with Table R602.3(1) and butted joists shall be tied together in a manner to resist such thrust.
- 282) R802.5.1. Installation of purlins to reduce the span of rafters is permitted as shown in Figure R802.5.1. Purlins shall be sized no less than the required size of the rafters that they support. Purlins shall be continuous and shall be supported by 2-inch by 4-inch braces installed to bearing walls at a slope not less than 45 degrees from the horizontal. The braces shall be spaced not more than 4 feet on center and the unbraced length of braces shall not exceed 8 feet.
- 283) R802.10.2. Wood trusses shall be designed in accordance with accepted engineering practice. The design and manufacture of metal-plate-connected wood trusses shall comply with ANSI/TPI 1. The truss design drawings shall be prepared by a registered professional.
- 284) R802.10.3. Trusses shall be braced to prevent rotation and provide lateral stability in accordance with the requirements specified in the construction documents for the building and on the individual truss design drawings. In the absence of specific bracing requirements, trusses shall be braced in accordance with the Building Component Safety Information (BCSI 1-03) Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses.
- 285) R802.10.4. Truss members shall not be cut, notched, drilled, spliced or otherwise altered in any way without the approval of a registered design professional. Alterations resulting in the addition of load (e.g., HVAC equipment, water heater) that exceeds the design load for the truss shall not be permitted without verification that the truss is capable of supporting such additional loading.
- 286) R802.10.5. Trusses shall be connected to wall plates by the use of approved connectors having a resistance to uplift of not less than 175 pounds and shall be installed in accordance with the manufacturer's specifications
- 287) R806.1. Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilation openings shall have a least dimension of  $\frac{1}{16}$  inch minimum and  $\frac{1}{4}$  inch maximum. Ventilation openings having a least dimension larger than  $\frac{1}{4}$  inch shall be provided with corrosion-resistant wire cloth screening, hardware cloth, or similar material with openings having a least dimension of  $\frac{1}{16}$  inch minimum and  $\frac{1}{4}$  inch maximum. Openings in roof framing members shall conform to the requirements of Section R802.7.
- 288) R806.2. The total net free ventilating area shall not be less than  $\frac{1}{150}$  of the area of the space ventilated except that reduction of the total area to  $\frac{1}{300}$  is permitted provided that at least 50 percent and not more than 80 percent of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least 3 feet above the eave or cornice vents with the balance of the required ventilation provided by eave or cornice vents. As an alternative, the net free cross-ventilation area may be reduced to  $\frac{1}{300}$  when a Class I or II vapor barrier is installed on the warm-in-winter side of the ceiling.
- 289) R806.3. Where eave or cornice vents are installed, insulation shall not block the free flow of air. A minimum of a 1-inch space shall be provided between the insulation and the roof sheathing and at the location of the vent.

- 290) R806.4. Unvented attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) shall be permitted if all the following conditions are met:
1. The unvented attic space is completely contained within the building thermal envelope.
  2. No interior vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly.
  3. Where wood shingles or shakes are used, a minimum  $\frac{1}{4}$  inch vented air space separates the shingles or shakes and the roofing underlayment above the structural sheathing.
  4. Does not apply to this area.
  5. Either Items 5.1, 5.2 or 5.3 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.
    - 5.1. Air-impermeable insulation only. Insulation shall be applied in direct contact with the underside of the structural roof sheathing.
    - 5.2. Air-permeable insulation only. In addition to the air-permeable installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R806.4 for condensation control.
    - 5.3. Air-impermeable and air-permeable insulation. The air-impermeable insulation shall be applied in direct contact with the underside of the structural roof sheathing as specified in Table R806.4 for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation.
- 291) R807.1 Attic access. Buildings with combustible ceiling or roof construction shall have an attic access opening to attic areas that exceed 30 square feet and have a vertical height of 30 inches or greater. The vertical height shall be measured from the top of the ceiling framing members to the underside of the roof framing members. The rough-framed opening shall not be less than 22 inches by 30 inches and shall be located in a hallway or other readily accessible location. When located in a wall, the opening shall be a minimum of 22 inches wide by 30 inches high. When the access is located in a ceiling, minimum unobstructed headroom in the attic space shall be 30 inches at some point above the access measured vertically from the bottom of ceiling framing members. See Section M1305.1.3 for access requirements where mechanical equipment is located in attics.
- 292) R903.1. Roof decks shall be covered with approved roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof assemblies shall be designed and installed in accordance with this code and the approved manufacturer's installation instructions such that the roof assembly shall serve to protect the building or structure.
- 293) R903.2. Flashings shall be installed in a manner that prevents moisture from entering the wall and roof through joints in copings, through moisture permeable materials and at intersections with parapet walls and other penetrations through the roof plane.
- 294) R903.2.1. Flashings shall be installed at wall and roof intersections, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than 0.019 inch (No. 26 galvanized sheet).
- 295) R903.2.2. A cricket or saddle shall be installed on the ridge side of any chimney or penetration more than 30 inches wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.
- 296) R903.4. Unless roofs are sloped to drain over roof edges, roof drains shall be installed at each low point of the roof. Where required for roof drainage, scuppers shall be placed level with the roof surface in a wall or parapet. The scupper shall be located as determined by the roof slope and contributing roof area.
- 297) R903.4.1. Where roof drains are required, overflow drains having the same size as the roof drains shall be installed with the inlet flow line located 2 inches above the low point of the roof, or overflow scuppers having three times the size of the roof drains and having a minimum opening height of 4 inches shall be installed in the adjacent parapet walls with the inlet flow located 2 inches above the low point of the roof served. The installation and sizing of overflow drains, leaders and conductors shall comply with the International Plumbing Code. Overflow drains shall discharge to an approved location and shall not be connected to roof drain lines.

- 298) R905.2.7. For roof slopes from two units vertical in 12 units horizontal (17-percent slope), up to four units vertical in 12 units horizontal (33-percent slope), underlayment shall be two layers applied in the following manner. Apply a 19-inch strip of underlayment felt parallel to and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inch-wide sheets of underlayment, overlapping successive sheets 19 inches, and fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of four units vertical in 12 units horizontal (33-percent slope) or greater, underlayment shall be one layer applied in the following manner. Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches, fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. End laps shall be offset by 6 feet.
- 299) R905.2.7.1. In areas where there has been a history of ice forming along the eaves causing a backup of water as designated in Table R301.2(1), an ice barrier that consists of a least two layers of underlayment cemented together or of a self-adhering polymer modified bitumen sheet, shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches inside the exterior wall line of the building.  
**Exception:** Detached accessory structures that contain no conditioned floor area.
- 300) R905.2.8.1. Base and cap flashing shall be installed in accordance with manufacturer's installation instructions. Base flashing shall be of either corrosion-resistant metal of minimum nominal 0.019-inch thickness or mineral surface roll roofing weighing a minimum of 77 pounds per 100 square feet. Cap flashing shall be corrosion-resistant metal of minimum nominal 0.019-inch thickness.
- 301) R905.2.8.2. Valley linings shall be installed in accordance with the manufacturer's installation instructions before applying shingles. Valley linings of the following types shall be permitted:
1. For open valleys (valley lining exposed) lined with metal, the valley lining shall be at least 24 inches wide and of any of the corrosion-resistant metals in Table R905.2.8.2.
  2. For open valleys, valley lining of two plies of mineral surfaced roll roofing, complying with ASTM D 3909 or ASTM D 6380 Class M, shall be permitted. The bottom layer shall be 18 inches and the top layer a minimum of 36 inches wide.
  3. For closed valleys (valley covered with shingles), valley lining of one ply of smooth roll roofing complying with ASTM D 6380 and at least 36 inches wide or valley lining as described in Item 1 or 2 above shall be permitted. Self-adhering polymer modified bitumen underlayment complying with ASTM D 1970 shall be permitted in lieu of the lining material.
- 302) R905.2.8.3. Flashing against a vertical sidewall shall be by the step-flashing method. The flashing shall be a minimum of 4 inches high and 4 inches wide. At the end of the vertical sidewall the step flashing shall be turned out in a manner that directs water away from the wall and onto the roof and/or gutter.
- 303) R905.2.8.4. Flashing against a vertical front wall, as well as soil stack, vent pipe and chimney flashing, shall be applied according to the asphalt shingle manufacturer's printed instructions.
- 304) R1001.2. Footings for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least 12 inches thick and shall extend at least 6 inches beyond the face of the fireplace or foundation wall on all sides. Footings shall be founded on natural, undisturbed earth or engineered fill below frost depth.
- 305) R1001.2.1. Cleanout openings located within foundation walls below fireboxes, when provided, shall be equipped with ferrous metal or masonry doors and frames constructed to remain tightly closed except when in use. Cleanouts shall be accessible and located so that ash removal will not create a hazard to combustible materials.
- 306) R1001.5. Masonry fireboxes shall be constructed of solid masonry units, hollow masonry units grouted solid, stone or concrete. When a lining of firebrick at least 2 inches thick or other approved lining is provided, the minimum thickness of back and side walls shall each be 8 inches of solid masonry, including the lining. The width of joints between firebricks shall not be greater than  $\frac{1}{4}$  inch. When no lining is provided, the total minimum thickness of back and side walls shall be 10 inches of solid masonry. Firebrick shall conform to ASTM C 27 or C 1261 and shall be laid with medium duty refractory mortar conforming to ASTM C 199.

- 307) R1001.6. The firebox of a concrete or masonry fireplace shall have a minimum depth of 20 inches. The throat shall not be less than 8 inches above the fireplace opening. The throat opening shall not be less than 4 inches deep. The cross-sectional area of the passageway above the firebox, including the throat, damper and smoke chamber, shall not be less than the cross-sectional area of the flue.  
**Exception:** Rumford fireplaces shall be permitted provided that the depth of the fireplace is at least 12 inches and at least one-third of the width of the fireplace opening, that the throat is at least 12 inches above the lintel and is at least  $\frac{1}{20}$  the cross-sectional area of the fireplace opening.
- 308) R1001.7. Masonry over a fireplace opening shall be supported by a lintel of noncombustible material. The minimum required bearing length on each end of the fireplace opening shall be 4 inches. The fireplace throat or damper shall be located a minimum of 8 inches above the lintel.
- 309) R1001.7.1. Masonry fireplaces shall be equipped with a ferrous metal damper located at least 8 inches above the top of the fireplace opening. Dampers shall be installed in the fireplace or the chimney venting the fireplace, and shall be operable from the room containing the fireplace.
- 310) R1001.8. Smoke chamber walls shall be constructed of solid masonry units, hollow masonry units grouted solid, stone or concrete. The total minimum thickness of front, back and side walls shall be 8 inches of solid masonry. The inside surface shall be parged smooth with refractory mortar conforming to ASTM C 199. When a lining of firebrick at least 2 inches thick, or a lining of vitrified clay at least  $\frac{5}{8}$  inch thick, is provided, the total minimum thickness of front, back and side walls shall be 6 inches of solid masonry, including the lining. Firebrick shall conform to ASTM C 1261 and shall be laid with medium duty refractory mortar conforming to ASTM C 199. Vitrified clay linings shall conform to ASTM C 315.
- 311) R1001.8.1. The inside height of the smoke chamber from the fireplace throat to the beginning of the flue shall not be greater than the inside width of the fireplace opening. The inside surface of the smoke chamber shall not be inclined more than 45 degrees from vertical when prefabricated smoke chamber linings are used or when the smoke chamber walls are rolled or sloped rather than corbeled. When the inside surface of the smoke chamber is formed by corbeled masonry, the walls shall not be corbeled more than 30 degrees from vertical.
- 312) R1001.9. Masonry fireplace hearths and hearth extensions shall be constructed of concrete or masonry, supported by noncombustible materials, and reinforced to carry their own weight and all imposed loads. No combustible material shall remain against the underside of hearths and hearth extensions after construction.
- 313) R1001.9.1. The minimum thickness of fireplace hearths shall be 4 inches.
- 314) R1001.9.2. The minimum thickness of hearth extensions shall be 2 inches.  
**Exception:** When the bottom of the firebox opening is raised at least 8 inches above the top of the hearth extension, a hearth extension of not less than  $\frac{3}{8}$ -inch-thick brick, concrete, stone, tile or other approved noncombustible material is permitted.
- 315) R1001.10. Hearth extensions shall extend at least 16 inches in front of and at least 8 inches beyond each side of the fireplace opening. Where the fireplace opening is 6 square feet or larger, the hearth extension shall extend at least 20 inches in front of and at least 12 inches beyond each side of the fireplace opening.
- 316) R1001.11. All wood beams, joists, studs and other combustible material shall have a clearance of not less than 2 inches from the front faces and sides of masonry fireplaces and not less than 4 inches from the back faces of masonry fireplaces. The air space shall not be filled, except to provide fire blocking in accordance with Section R1001.12.  
**Exceptions:**  
1. Masonry fireplaces listed and labeled for use in contact with combustibles in accordance with UL 127 and installed in accordance with the manufacturer's installation instructions are permitted to have combustible material in contact with their exterior surfaces.

2. When masonry fireplaces are part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete walls less than 12 inches from the inside surface of the nearest firebox lining.
3. Exposed combustible trim and the edges of sheathing materials such as wood siding, flooring and drywall shall be permitted to abut the masonry fireplace side walls and hearth extension in accordance with Figure R1001.11, provided such combustible trim or sheathing is a minimum of 12 inches from the inside surface of the nearest firebox lining.
4. Exposed combustible mantels or trim may be placed directly on the masonry fireplace front surrounding the fireplace opening providing such combustible materials are not placed within 6 inches of a fireplace opening. Combustible material within 12 inches of the fireplace opening shall not project more than  $\frac{1}{8}$  inch for each 1-inch distance from such an opening.

- 317) R1001.12. Fireplace fireblocking shall comply with the provisions of Section R602.8.
- 318) R1003.2. Footings for masonry chimneys shall be constructed of concrete or solid masonry at least 12 inches thick and shall extend at least 6 inches beyond the face of the foundation or support wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth.
- 319) R1003.5. Masonry chimneys shall not be corbeled more than one-half of the chimney's wall thickness from a wall or foundation, nor shall a chimney be corbeled from a wall or foundation that is less than 12 inches thick unless it projects equally on each side of the wall, except that on the second story of a two-story dwelling, corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. The projection of a single course shall not exceed one-half the unit height or one-third of the unit bed depth, whichever is less.
- 320) R1003.6. The chimney wall or chimney flue lining shall not change in size or shape within 6 inches above or below where the chimney passes through floor components, ceiling components or roof components.
- 321) R1003.7. Where a masonry chimney is constructed with a fireclay flue liner surrounded by one wythe of masonry, the maximum offset shall be such that the centerline of the flue above the offset does not extend beyond the center of the chimney wall below the offset. Where the chimney offset is supported by masonry below the offset in an approved manner, the maximum offset limitations shall not apply. Each individual corbeled masonry course of the offset shall not exceed the projection limitations specified in Section R1003.5.
- 322) R1003.8. Chimneys shall not support loads other than their own weight unless they are designed and constructed to support the additional load. Construction of masonry chimneys as part of the masonry walls or reinforced concrete walls of the building shall be permitted.
- 323) R1003.9. Chimneys shall extend at least 2 feet higher than any portion of a building within 10 feet, but shall not be less than 3 feet above the highest point where the chimney passes through the roof.
- 324) R1003.9.1. Where a spark arrestor is installed on a masonry chimney, the spark arrestor shall meet all of the following requirements:
1. The net free area of the arrestor shall not be less than four times the net free area of the outlet of the chimney flue it serves.
  2. The arrestor screen shall have heat and corrosion resistance equivalent to 19-gage galvanized steel or 24-gage stainless steel.
  3. Openings shall not permit the passage of spheres having a diameter greater than  $\frac{1}{2}$  inch nor block the passage of spheres having a diameter less than  $\frac{3}{8}$  inch.
  4. The spark arrestor shall be accessible for cleaning and the screen or chimney cap shall be removable to allow for cleaning of the chimney flue.
- 325) R1003.10. Masonry chimney walls shall be constructed of solid masonry units or hollow masonry units grouted solid with not less than a 4-inch nominal thickness.
- 326) R1003.10.1. Where masonry is used to veneer a frame chimney, through-flashing and weep holes shall be installed as required by Section R703.

- 327) R1003.11. Masonry chimneys shall be lined. The lining material shall be appropriate for the type of appliance connected, according to the terms of the appliance listing and manufacturer's instructions.
- 328) R1003.11.1. Flue lining systems shall comply with one of the following:
1. Clay flue lining complying with the requirements of ASTM C 315.
  2. Listed chimney lining systems complying with UL 1777.
  3. Factory-built chimneys or chimney units listed for installation within masonry chimneys.
  4. Other approved materials that will resist corrosion, erosion, softening or cracking from flue gases and condensate at temperatures up to 1,800°F.
- 329) R1003.11.3. Flue lining systems for gas appliances shall be in accordance with Chapter 24.
- 330) R1003.11.4. Flue lining and vent systems for use in masonry chimneys with pellet fuel-burning appliances shall be limited to the following:
1. Flue lining systems complying with Section R1003.11.1.
  2. Pellet vents listed for installation within masonry chimneys. (See Section R1003.11.6 for marking.)
- 331) R1003.11.5. Flue lining and vent systems for use in masonry chimneys with oil-fired appliances approved for use with Type L vent shall be limited to the following:
1. Flue lining systems complying with Section R1003.11.1.
  2. Listed chimney liners complying with UL 641. (See Section R1003.11.6 for marking.)
- 332) R1003.11.6. When a flue is relined with a material not complying with Section R1003.11.1, the chimney shall be plainly and permanently identified by a label attached to a wall, ceiling or other conspicuous location adjacent to where the connector enters the chimney. The label shall include the following message or equivalent language: THIS CHIMNEY FLUE IS FOR USE ONLY WITH [TYPE OR CATEGORY OF APPLIANCE] APPLIANCES THAT BURN [TYPE OF FUEL]. DO NOT CONNECT OTHER TYPES OF APPLIANCES.
- 333) R1003.12. Clay flue liners shall be installed in accordance with ASTM C 1283 and extend from a point not less than 8 inches below the lowest inlet or, in the case of fireplaces, from the top of the smoke chamber to a point above the enclosing walls. The lining shall be carried up vertically, with a maximum slope no greater than 30 degrees from the vertical. Clay flue liners shall be laid in medium-duty water insoluble refractory mortar conforming to ASTM C 199 with tight mortar joints left smooth on the inside and installed to maintain an air space or insulation not to exceed the thickness of the flue liner separating the flue liners from the interior face of the chimney masonry walls. Flue liners shall be supported on all sides. Only enough mortar shall be placed to make the joint and hold the liners in position.
- 334) R1003.12.1. Listed materials used as flue linings shall be installed in accordance with the terms of their listings and manufacturer's instructions.
- 335) R1003.12.2. The space surrounding a chimney lining system or vent installed within a masonry chimney shall not be used to vent any other appliance.  
**Exception:** This shall not prevent the installation of a separate flue lining in accordance with the manufacturer's installation instructions.
- 336) R1003.13. When two or more flues are located in the same chimney, masonry wythes shall be built between adjacent flue linings. The masonry wythes shall be at least 4 inches thick and bonded into the walls of the chimney.  
**Exception:** When venting only one appliance, two flues may adjoin each other in the same chimney with only the flue lining separation between them. The joints of the adjacent flue linings shall be staggered at least 4 inches.
- 337) R1003.14. Chimney flues shall not be smaller in area than that of the area of the connector from the appliance [see Tables R1003.14(1) and R1003.14(2)]. The sizing of a chimney flue to which multiple appliance venting systems are connected shall be in accordance with Section M1805.3.



- 338) R1003.15. Flue sizing for chimneys serving fireplaces shall be in accordance with Section R1003.15.1 or Section R1003.15.2.
- 339) R1003.15.1 *Option 1*. Round chimney flues shall have a minimum net cross-sectional area of at least  $\frac{1}{12}$  of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of  $\frac{1}{10}$  of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2 to 1 shall have a minimum net cross-sectional area of  $\frac{1}{10}$  of the fireplace opening. Rectangular chimney flues with an aspect ratio of 2 to 1 or more shall have a minimum net cross-sectional area of  $\frac{1}{8}$  of the fireplace opening. Cross-sectional areas of clay flue linings are shown in Tables R1001.14(1) and R1001.14(2) or as provided by the manufacturer or as measured in the field.
- 340) R1003.15.2 *Option 2*. The minimum net cross-sectional area of the chimney flue shall be determined in accordance with Figure R1003.15.2. A flue size providing at least the equivalent net cross-sectional area shall be used. Cross-sectional areas of clay flue linings are shown in Tables R1003.14(1) and R1003.14(2) or as provided by the manufacturer or as measured in the field. The height of the chimney shall be measured from the firebox floor to the top of the chimney flue.
- 341) R1003.16. Inlets to masonry chimneys shall enter from the side. Inlets shall have a thimble of fireclay, rigid refractory material or metal that will prevent the connector from pulling out of the inlet or from extending beyond the wall of the liner.
- 342) R1003.17. Cleanout openings shall be provided within 6 inches of the base of each flue within every masonry chimney. The upper edge of the cleanout shall be located at least 6 inches below the lowest chimney inlet opening. The height of the opening shall be at least 6 inches. The cleanout shall be provided with a noncombustible cover.
- Exception:** Chimney flues serving masonry fireplaces where cleaning is possible through the fireplace opening.
- 343) R1003.18. Any portion of a masonry chimney located in the interior of the building or within the exterior wall of the building shall have a minimum air space clearance to combustibles of 2 inches. Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum air space clearance of 1 inch. The air space shall not be filled, except to provide fire blocking in accordance with Section R1003.19.
- Exceptions:**
1. Masonry chimneys equipped with a chimney lining system listed and labeled for use in chimneys in contact with combustibles in accordance with UL 1777 and installed in accordance with the manufacturer's installation instructions are permitted to have combustible material in contact with their exterior surfaces.
  2. When masonry chimneys are constructed as part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete wall less than 12 inches from the inside surface of the nearest flue lining.
  3. Exposed combustible trim and the edges of sheathing materials, such as wood siding and flooring, shall be permitted to abut the masonry chimney side walls, in accordance with Figure R1003.18, provided such combustible trim or sheathing is a minimum of 12 inches from the inside surface of the nearest flue lining. Combustible material and trim shall not overlap the corners of the chimney by more than 1 inch.
- 344) R1003.19. All spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between chimneys and wood joists, beams or headers shall be self-supporting or be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.
- 345) R1003.20. Chimneys shall be provided with crickets when the dimension parallel to the ridgeline is greater than 30 inches and does not intersect the ridgeline. The intersection of the cricket and the chimney shall be flashed and counterflashed in the same manner as normal roof-chimney intersections. Crickets shall be constructed in compliance with Figure R1003.20 and Table R1003.20.

- 346) R1004.2. Hearth extensions of approved factory-built fireplaces shall be installed in accordance with the listing of the fireplace. The hearth extension shall be readily distinguishable from the surrounding floor area.
- 347) R1004.3. Decorative shrouds shall not be installed at the termination of chimneys for factory-built fireplaces except where the shrouds are listed and labeled for use with the specific factory-built fireplace system and installed in accordance with the manufacturer's installation instructions.
- 348) R1004.4. An unvented gas log heater shall not be installed in a factory-built fireplace unless the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.
- 349) R1005.1. Factory-built chimneys shall be listed and labeled and shall be installed and terminated in accordance with the manufacturer's installation instructions.
- 350) R1005.2. Decorative shrouds shall not be installed at the termination of factory-built chimneys except where the shrouds are listed and labeled for use with the specific factory-built chimney system and installed in accordance with the manufacturer's installation instructions.
- 351) R1005.3. Factory-built chimneys installed in dwelling units with solid-fuel-burning appliances shall comply with the Type HT requirements of UL 103 and shall be marked "Type HT and "Residential Type and Building Heating Appliance Chimney."  
**Exception:** Chimneys for use with open combustion chamber fireplaces shall comply with the requirements of UL 103 and shall be marked "Residential Type and Building Heating Appliance Chimney."  
Chimneys for use with open combustion chamber appliances installed in buildings other than dwelling units shall comply with the requirements of UL 103 and shall be marked "Building Heating Appliance Chimney" or "Residential Type and Building Heating Appliance Chimney."
- 352) R1005.5. Where factory-built chimneys are supported by structural members, such as joists and rafters, those members shall be designed to support the additional load.
- 353) R1006.1. Factory-built or masonry fireplaces covered in this chapter shall be equipped with an exterior air supply to assure proper fuel combustion unless the room is mechanically ventilated and controlled so that the indoor pressure is neutral or positive.
- 354) R1006.1.1. Exterior combustion air ducts for factory-built fireplaces shall be a listed component of the fireplace and shall be installed according to the fireplace manufacturer's instructions.
- 355) R1006.1.2. Listed combustion air ducts for masonry fireplaces shall be installed according to the terms of their listing and the manufacturer's instructions.
- 356) R1006.2. The exterior air intake shall be capable of supplying all combustion air from the exterior of the dwelling or from spaces within the dwelling ventilated with outside air such as nonmechanically ventilated crawl or attic spaces. The exterior air intake shall not be located within the garage or basement of the dwelling nor shall the air intake be located at an elevation higher than the firebox. The exterior air intake shall be covered with a corrosion-resistant screen of  $\frac{1}{4}$ -inch mesh.
- 357) R1006.3. Unlisted combustion air ducts shall be installed with a minimum 1-inch clearance to combustibles for all parts of the duct within 5 feet of the duct outlet.
- 358) R1006.4. The combustion air passageway shall be a minimum of 6 square inches and not more than 55 square inches, except that combustion air systems for listed fireplaces shall be constructed according to the fireplace manufacturer's instructions.

- 359) R1006.5. Locating the exterior air outlet in the back or sides of the firebox chamber or within 24 inches of the firebox opening on or near the floor is permitted. The outlet shall be closable and designed to prevent burning material from dropping into concealed combustible spaces.
- 360) M1202.1. Additions, alterations, renovations or repairs to a mechanical system shall conform to the requirements for a new mechanical system without requiring the existing mechanical system to comply with all of the requirements of this code. Additions, alterations or repairs shall not cause an existing mechanical system to become unsafe, hazardous or overloaded. Minor additions, alterations or repairs to existing mechanical systems shall meet the provisions for new construction, unless such work is done in the same manner and arrangement as was in the existing system, is not hazardous, and is approved.
- 361) M1202.2 Existing installations. Except as otherwise provided for in this code, a provision in this code shall not require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing mechanical system lawfully in existence at the time of the adoption of this code.
- 362) M1202.3. Mechanical systems, both existing and new, and parts thereof shall be maintained in proper operating condition in accordance with the original design and in a safe and sanitary condition. Devices or safeguards that are required by this code shall be maintained in compliance with the code edition under which installed. The owner or the owner's designated agent shall be responsible for maintenance of the mechanical systems. To determine compliance with this provision, the building official shall have the authority to require a mechanical system to be reinspected.
- 363) M1305.1. Appliances shall be accessible for inspection, service, repair and replacement without removing permanent construction, other appliances, or any other piping or ducts not connected to the appliance being inspected, serviced, repaired or replaced. A level working space at least 30 inches deep and 30 inches wide shall be provided in front of the control side to service an appliance. Installation of room heaters shall be permitted with at least an 18-inch working space. A platform shall not be required for room heaters.
- 364) M1305.1.1. Furnaces and air handlers within compartments or alcoves shall have a minimum working space clearance of 3 inches along the sides, back and top with a total width of the enclosing space being at least 12 inches wider than the furnace or air handler. Furnaces having a firebox open to the atmosphere shall have at least a 6-inch working space along the front combustion chamber side. Combustion air openings at the rear or side of the compartment shall comply with the requirements of Chapter 17.  
**Exception:** This section shall not apply to replacement appliances installed in existing compartments and alcoves where the working space clearances are in accordance with the equipment or appliance manufacturer's installation instructions.
- 365) M1305.1.2. Appliances installed in a compartment, alcove, basement or similar space shall be accessed by an opening or door and an unobstructed passageway measuring not less than 24 inches wide and large enough to allow removal of the largest appliance in the space, provided there is a level service space of not less than 30 inches deep and the height of the appliance, but not less than 30 inches, at the front or service side of the appliance with the door open.
- 366) M1305.1.3. (Amended) Attics containing appliances shall be provided with an opening and a clear and unobstructed passageway large enough to allow removal of the largest appliance, but not less than 30 inches high and 22 inches wide and not more than 20 feet long measured along the centerline of the passageway from the opening to the appliance. Access to the attic opening shall be provided by a permanent or pull-down stairway in all new construction. In existing installations, portable ladders shall be acceptable. The passageway shall have continuous solid flooring in accordance with Chapter 5 not less than 24 inches wide. A level service space at least 30 inches deep and 30 inches wide shall be present along all sides of the appliance where access is required. The clear access opening dimensions shall be a minimum of 20 inches by 30 inches, and large enough to allow removal of the largest appliance.  
**Exceptions:**  
1. The passageway and level service space are not required where the appliance can be serviced and removed through the required opening.

2. Where the passageway is unobstructed and not less than 6 feet high and 22 inches wide for its entire length, the passageway shall be not more than 50 feet long.

- 367) M1305.1.3.1. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be installed at or near the appliance location in accordance with 2008 NEC.
- 368) M1305.1.4. Underfloor spaces containing appliances shall be provided with an unobstructed passageway large enough to remove the largest appliance, but not less than 30 inches high and 22 inches wide, nor more than 20 feet long measured along the centerline of the passageway from the opening to the appliance. A level service space at least 30 inches deep and 30 inches wide shall be present at the front or service side of the appliance. If the depth of the passageway or the service space exceeds 12 inches below the adjoining grade, the walls of the passageway shall be lined with concrete or masonry extending 4 inches above the adjoining grade in accordance with Chapter 4. The rough-framed access opening dimensions shall be a minimum of 22 inches by 30 inches, and large enough to remove the largest appliance.
- Exceptions:**
1. The passageway is not required where the level service space is present when the access is open, and the appliance can be serviced and removed through the required opening.
  2. Where the passageway is unobstructed and not less than 6 feet high and 22 inches wide for its entire length, the passageway shall not be limited in length.
- 369) M1305.1.4.1. Equipment and appliances supported from the ground shall be level and firmly supported on a concrete slab or other approved material extending not less than 3 inches above the adjoining ground. Such support shall be in accordance with the manufacturer's installation instructions. Appliances suspended from the floor shall have a clearance of not less than 6 inches from the ground.
- 370) M1305.1.4.2. Excavations for appliance installations shall extend to a depth of 6 inches below the appliance and 12 inches on all sides, except that the control side shall have a clearance of 30 inches.
- 371) M1305.1.4.3. A luminaire controlled by a switch located at the required passageway opening and a receptacle outlet shall be installed at or near the appliance location in accordance with 2008 NEC.
- 372) M1307.1. Installation of appliances shall conform to the conditions of their listing and label and the manufacturer's installation instructions. The manufacturer's operating and installation instructions shall remain attached to the appliance.
- 373) M1307.3. Appliances having an ignition source shall be elevated such that the source of ignition is not less than 18 inches above the floor in garages. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate with a private garage through openings shall be considered to be part of the garage.
- 374) M1307.3.1. Appliances shall not be installed in a location subject to vehicle damage except where protected by approved barriers.
- 375) M1307.6. Potable water and drainage system connections to equipment and appliances regulated by this code shall be in accordance with WSSC regulations.
- 376) M1308.2. In concealed locations where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1.5 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575-inch (No. 16 gage), shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- 377) M1401.1. Heating and cooling equipment and appliances shall be installed in accordance with the manufacturer's installation instructions and the requirements of this code.

- 378) M1401.2. Heating and cooling equipment shall be located with respect to building construction and other equipment to permit maintenance, servicing and replacement. Clearances shall be maintained to permit cleaning of heating and cooling surfaces; replacement of filters, blowers, motors, controls and vent connections; lubrication of moving parts; and adjustments.
- 379) M1401.3. Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.
- 380) M1401.4. Equipment installed outdoors shall be listed and labeled for outdoor installation. Supports and foundations shall prevent excessive vibration, settlement or movement of the equipment. Supports and foundations shall be level and conform to the manufacturer's installation instructions.
- 381) M1403.1. The minimum unobstructed total area of the outside and return air ducts or openings to a heat pump shall be not less than 6 square inches per 1,000 Btu/h output rating or as indicated by the conditions of the listing of the heat pump. Electric heat pumps shall conform to UL 1995.
- 382) M1403.2. Supports and foundations for the outdoor unit of a heat pump shall be raised at least 3 inches above the ground to permit free drainage of defrost water, and shall conform to the manufacturer's installation instructions.
- 383) M1411.3. Condensate from all cooling coils or evaporators shall be conveyed from the drain pan outlet to an approved place of disposal. Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than  $\frac{1}{8}$  unit vertical in 12 units horizontal (1-percent slope). Condensate shall not discharge into a street, alley or other areas where it would cause a nuisance.
- 384) M1411.3.1. In addition to the requirements of Section M1411.3, a secondary drain or auxiliary drain pan shall be required for each cooling or evaporator coil where damage to any building components will occur as a result of overflow from the equipment drain pan or stoppage in the condensate drain piping. Such piping shall maintain a minimum horizontal slope in the direction of discharge of not less than  $\frac{1}{8}$  unit vertical in 12 units horizontal (1-percent slope). Drain piping shall be a minimum of  $\frac{3}{4}$ -inch nominal pipe size. One of the following methods shall be used:
1. An auxiliary drain pan with a separate drain shall be installed under the coils on which condensation will occur. The auxiliary pan drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The pan shall have a minimum depth of 1.5 inches, shall not be less than 3 inches larger than the unit or the coil dimensions in width and length and shall be constructed of corrosion-resistant material. Galvanized sheet steel pans shall have a minimum thickness of not less than 0.0236-inch (No. 24 Gage). Nonmetallic pans shall have a minimum thickness of not less than 0.0625 inch.
  2. A separate overflow drain line shall be connected to the drain pan installed with the equipment. This overflow drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The overflow drain line shall connect to the drain pan at a higher level than the primary drain connection.
  3. An auxiliary drain pan without a separate drain line shall be installed under the coils on which condensation will occur. This pan shall be equipped with a water level detection device conforming to UL 508 that will shut off the equipment served prior to overflow of the pan. The pan shall be equipped with a fitting to allow for drainage. The auxiliary drain pan shall be constructed in accordance with Item 1 of this section.
  4. A water level detection device conforming to UL 508 shall be installed that will shut off the equipment served in the event that the primary drain is blocked. The device shall be installed in the primary drain line, the overflow drain line or the equipment-supplied drain pan, located at a point higher than the primary drain line connection and below the overflow rim of such pan.
- 385) M1411.3.1.1. On down-flow units and all other coils that have no secondary drain or provisions to install a secondary or auxiliary drain pan, a water-level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served in the event that the primary drain becomes restricted. Devices shall not be installed in the drain line.

- 386) M1411.3.2. Condensate waste and drain line size shall be not less than  $\frac{3}{4}$ -inch internal diameter and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method.
- 387) M1411.4. Category IV condensing appliances shall have an auxiliary drain pan where damage to any building component will occur as a result of stoppage in the condensate drainage system. **Exception:** Fuel-fired appliances that automatically shut down operation in the event of a stoppage in the condensate drainage system.
- 388) M1411.5. Piping and fittings for refrigerant vapor (suction) lines shall be insulated with insulation having a thermal resistivity of at least R-4.
- 389) M1411.6. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps.
- 390) M1501.1. The air removed by every mechanical exhaust system shall be discharged to the outdoors. Air shall not be exhausted into an attic, soffit, ridge vent or crawl space.  
**Exception:** Whole-house ventilation-type attic fans that discharge into the attic space of dwelling units having private attics shall be permitted.
- 391) M1502.1. Clothes dryers shall be exhausted in accordance with the manufacturer's instructions.
- 392) M1502.2. Dryer exhaust systems shall be independent of all other systems and shall convey the moisture to the outdoors.  
**Exception:** This section shall not apply to listed and labeled condensing (ductless) clothes dryers.
- 393) M1502.3. Exhaust ducts shall terminate on the outside of the building. Exhaust duct terminations shall be in accordance with the dryer manufacturer's installation instructions. If the manufacturer's instructions do not specify a termination location, the exhaust duct shall terminate not less than 3 feet in any direction from openings into buildings. Exhaust duct terminations shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination.
- 394) M1502.4.1. Exhaust ducts shall have a smooth interior finish and shall be constructed of metal a minimum 0.016-inch thick. The exhaust duct size shall be 4 inches nominal in diameter.
- 395) M1502.4.2. Exhaust ducts shall be supported at 4 foot intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude into the inside of the duct.
- 396) M1502.4.3. Transition ducts used to connect the dryer to the exhaust duct system shall be a single length that is listed and labeled in accordance with UL 2158A. Transition ducts shall be a maximum of 8 feet in length. Transition ducts shall not be concealed within construction.
- 397) M1502.4.4.1. The maximum length of the exhaust duct shall be 25 feet from the connection to the transition duct from the dryer to the outlet terminal. Where fittings are used, the maximum length of the exhaust duct shall be reduced in accordance with Table M1502.4.4.1.
- 398) M1502.4.4.2. The size and maximum length of the exhaust duct shall be determined by the dryer manufacturer's installation instructions. The code official shall be provided with a copy of the installation instructions for the make and model of the dryer at the concealment inspection. In the absence of fitting equivalent length calculations from the clothes dryer manufacturer, Table M1502.4.4.1 shall be used.
- 399) M1502.4.5. Where the exhaust duct is concealed within the building construction, the equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet of the exhaust duct connection.

- 400) M1502.4.6. Where space for a clothes dryer is provided, an exhaust duct system shall be installed. Where the clothes dryer is not installed at the time of occupancy the exhaust duct shall be capped or plugged in the space in which it originates and identified and marked "future use."  
**Exception:** Where a listed condensing clothes dryer is installed prior to occupancy of the structure.
- 401) M1502.5. Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than  $1\frac{1}{4}$  inches between the duct and the finished face of the framing member. Protective shield plates shall be constructed of steel, shall have a minimum thickness of 0.062-inch and shall extend a minimum of 2 inches above sole plates and below top plates.
- 402) M1503.1. Range hoods shall discharge to the outdoors through a single-wall duct. The duct serving the hood shall have a smooth interior surface, shall be air tight and shall be equipped with a backdraft damper. Ducts serving range hoods shall not terminate in an attic or crawl space or areas inside the building.  
**Exception:** Where installed in accordance with the manufacturer's installation instructions, and where mechanical or natural ventilation is otherwise provided, listed and labeled ductless range hoods shall not be required to discharge to the outdoors.
- 403) M1503.4. Exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.
- 404) M1505.1. Domestic open-top broiler units shall have a metal exhaust hood, having a minimum thickness of 0.0157-inch (No. 28 gage) with  $\frac{1}{4}$  inch clearance between the hood and the underside of combustible material or cabinets. A clearance of at least 24 inches shall be maintained between the cooking surface and the combustible material or cabinet. The hood shall be at least as wide as the broiler unit, extend over the entire unit, discharge to the outdoors and be equipped with a backdraft damper or other means to control infiltration/exfiltration when not in operation. Broiler units incorporating an integral exhaust system, and listed and labeled for use without an exhaust hood, need not have an exhaust hood.
- 405) M1507.2. Exhaust air from bathrooms and toilet rooms shall not be recirculated within a residence or to another dwelling unit and shall be exhausted directly to the outdoors. Exhaust air from bathrooms and toilet rooms shall not discharge into an attic, crawl space or other areas inside the building.
- 406) M1507.3. Ventilation systems shall be designed to have the capacity to exhaust the minimum air flow rate determined in accordance with Table M1507.3.
- 407) M1601.1. Duct systems serving heating, cooling and ventilation equipment shall be fabricated in accordance with the provisions of this section and ACCA Manual D or other approved methods.
- 408) M1601.2. Factory-made air ducts or duct material shall be approved for the use intended, and shall be installed in accordance with the manufacturer's installation instructions. Each portion of a factory-made air duct system shall bear a listing and label indicating compliance with UL 181 and UL 181A or UL 181B.
- 409) M1601.3. Duct insulation materials shall conform to the following requirements:  
1. Duct coverings and linings, including adhesives where used, shall have a flame spread index not higher than 25, and a smoke-developed index not over 50 when tested in accordance with ASTM E 84 or UL 723, using the specimen preparation and mounting procedures of ASTM E 2231.  
**Exception:** Spray application of polyurethane foam to the exterior of ducts in attics and crawl spaces shall be permitted subject to all of the following:  
1. The flame spread index is not greater than 25 and the smoke-developed index is not greater than 450 at the specified installed thickness.  
2. The foam plastic is protected in accordance with the ignition barrier requirements of Sections R316.5.3 and R316.5.4.

3. The foam plastic complies with the requirements of Section R316.
  2. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250 °F.
  3. External duct insulation and factory-insulated flexible ducts shall be legibly printed or identified at intervals not longer than 36 inches with the name of the manufacturer, the thermal resistance R-value at the specified installed thickness and the flame spread and smoke-developed indexes of the composite materials. Spray polyurethane foam manufacturers shall provide the same product information and properties, at the nominal installed thickness, to the customer in writing at the time of foam application. All duct insulation product R-values shall be based on insulation only, excluding air films, vapor retarders or other duct components, and shall be based on tested C-values at 75 °F mean temperature at the installed thickness, in accordance with recognized industry procedures. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:
    - 3.1. For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
    - 3.2. For ductwrap, the installed thickness shall be assumed to be 75 percent (25-percent compression) of nominal thickness.
    - 3.3. For factory-made flexible air ducts, The installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.
    - 3.4. For spray polyurethane foam, the aged R-value per inch measured in accordance with recognized industry standards shall be provided to the customer in writing at the time of foam application. In addition, the total R-value for the nominal application thickness shall be provided.
- 410) M1601.4.1. Joints of duct systems shall be made substantially airtight by means of tapes, mastics, liquid sealants, gasketing or other approved closure systems. Closure systems used with rigid fibrous glass ducts shall comply with UL181A and shall be marked 181A-P for pressure-sensitive tape, 181A-M for mastic or 181 A-H for heat-sensitive tape. Closure systems used with flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked 181B-FX for pressure-sensitive tape or 181B-M for mastic. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked 181B-C. Crimp joints for round metal ducts shall have a contact lap of at least 1½ inches and shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint. Closure systems used to seal metal ductwork shall be installed in accordance with the manufacturer's installation instructions.
- Exceptions:**
1. Spray polyurethane foam shall be permitted to be applied without additional joint seals.
  2. Where a duct connection is made that is partially inaccessible, three screws or rivets shall be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
  3. Continuously welded and locking type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column (500 Pa) pressure classification shall not require additional closure systems.
- 411) M1601.4.3. Metal ducts shall be supported by ½-inch wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet or other approved means. Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.
- 412) M1601.4.5. Duct insulation shall be installed in accordance with the following requirements:
1. A vapor retarder having a maximum permeance of 0.05 perm in accordance with ASTM E 96, or aluminum foil with a minimum thickness of 2 mils, shall be installed on the exterior of insulation on cooling supply ducts that pass through unconditioned spaces conducive to condensation except where the insulation is spray polyurethane foam with a maximum water vapor permeance of 3 perm per inch at the installed thickness.
  2. Exterior duct systems shall be protected against the elements.
  3. Duct coverings shall not penetrate a fireblocked wall or floor.
- 413) M 1601.4.7. Ducts shall be installed with at least 4 inches separation from earth except where they meet the requirements of Section M1601.1.2.
- 414) M1601.5. Under-floor plenums shall be prohibited in new structures.



- 415) M1601.6. Furnaces and air-handling systems that supply air to living spaces shall not supply air to or return air from a garage.
- 416) M1602.1. Return air shall be taken from inside the dwelling. Dilution of return air with outdoor air shall be permitted.
- 417) M1602.2. Outdoor and return air for a forced-air heating or cooling system shall not be taken from the following locations:
1. Closer than 10 feet to an appliance vent outlet, a vent opening from a plumbing drainage system or the discharge outlet of an exhaust fan, unless the outlet is 3 feet above the outside air inlet.
  2. Where flammable vapors are present; or where located less than 10 feet above the surface of any abutting public way or driveway; or where located at grade level by a sidewalk, street, alley or driveway.
  3. A room or space, the volume of which is less than 25 percent of the entire volume served by the system. Where connected by a permanent opening having an area sized in accordance with ACCA Manual D, adjoining rooms or spaces shall be considered as a single room or space for the purpose of determining the volume of the rooms or spaces.
- Exception:** The minimum volume requirement shall not apply where the amount of return air taken from a room or space is less than or equal to the amount of supply air delivered to the room or space.
4. A closet, bathroom, toilet room, kitchen, garage, mechanical room, boiler room, furnace room, unconditioned attic or other dwelling unit.
  5. A room or space containing a fuel-burning appliance where such room or space serves as the sole source of return air.
- Exceptions:**
1. The fuel-burning appliance is a direct-vent appliance or an appliance not requiring a vent in accordance with Section M1801.1 or Chapter 24.
  2. The room or space complies with the following requirements:
    - 2.1. The return air shall be taken from a room or space having a volume exceeding 1 cubic foot for each 10 Btu/h of combined input rating of all fuel-burning appliances therein.
    - 2.2. The volume of supply air discharged back into the same space shall be approximately equal to the volume of return air taken from the space.
    - 2.3. Return-air inlets shall not be located within 10 feet of any appliance firebox or draft hood in the same room or space.
  3. Rooms or spaces containing solid-fuel burning appliances, if return-air inlets are located not less than 10 feet from the firebox of those appliances.
  6. An unconditioned crawl space by means of direct connection to the return side of a forced air system. Transfer openings in the crawl space enclosure shall not be prohibited.
- 418) M1602.3. Outdoor air inlets shall be covered with screens having openings that are not less than  $\frac{1}{4}$  inch and not greater than  $\frac{1}{2}$  inch.
- 419) M1801.6. Direct-vent appliances shall be installed in accordance with the manufacturer's installation instructions.
- 420) M1801.7. Venting systems shall be adequately supported for the weight of the material used.
- 421) M1801.8. Chimneys, vents and vent connectors shall not extend into or through supply and return air ducts or plenums.
- 422) M1801.10. Unused openings in any venting system shall be closed or capped.
- 423) M1801.11. Two or more listed and labeled appliances connected to a common natural draft venting system shall comply with the following requirements:
1. Appliances that are connected to common venting systems shall be located on the same floor of the dwelling.
- Exception:** Engineered systems as provided for in Section G2427.
2. Inlets to common venting systems shall be offset such that no portion of an inlet is opposite another inlet.

3. Connectors serving appliances operating under a natural draft shall not be connected to any portion of a mechanical draft system operating under positive pressure.
- 424) M1801.12. A solid-fuel-burning appliance or fireplace shall not connect to a chimney passageway venting another appliance.
- 425) G2411.1. Each above-ground portion of a gas piping system other than corrugated stainless steel tubing (CSST), that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than CSST, shall be considered to be bonded where it is connected to appliances that are connected to the equipment grounding conductor of the circuit supplying that appliance.
- 426) G2411.1.1. Corrugated stainless steel tubing (CSST) gas piping systems shall be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding jumper shall be not smaller than 6 AWG copper wire or equivalent.
- 427) G2420.1.2. Shutoff valves shall be prohibited in concealed locations and furnace plenums.
- 428) G2420.1.3. Shutoff valves shall be located in places so as to provide access for operation and shall be installed so as to be protected from damage.
- 429) G2420.3. In a common system serving more than one building, shutoff valves shall be installed outdoors at each building.
- 430) G2420.5.1. The shutoff valve shall be located in the same room as the appliance. The shutoff valve shall be within 6 feet of the appliance, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff valves shall be provided with access. Appliance shutoff valves located in the firebox of a fireplace shall be installed in accordance with the appliance manufacturer's instructions.
- 431) G2420.5.2. Shutoff valves for vented decorative appliances, room heaters and decorative appliances for installation in vented fireplaces shall be permitted to be installed in an area remote from the appliances where such valves are provided with ready access. Such valves shall be permanently identified and shall serve no other appliance. The piping from the shutoff valve to within 6 feet of the appliance shall be designed, sized and installed in accordance with Sections G2412 through G2419.
- 432) G2420.5.3. Where the appliance shutoff valve is installed at a manifold, such shutoff valve shall be located within 50 feet of the appliance served and shall be readily accessible and permanently identified. The piping from the manifold to within 6 feet of the appliance shall be designed, sized and installed in accordance with Sections G2412 through G2419.
- 433) G2422.1. Appliances shall be connected to the piping system by one of the following:
1. Rigid metallic pipe and fittings.
  2. Corrugated stainless steel tubing (CSST) where installed in accordance with the manufacturer's instructions.
  3. Listed and labeled appliance connectors in compliance with ANSI Z21.24 and installed in accordance with the manufacturer's installation instructions and located entirely in the same room as the appliance.
  4. Listed and labeled quick-disconnect devices used in conjunction with listed and labeled appliance connectors.
  5. Listed and labeled convenience outlets used in conjunction with listed and labeled appliance connectors.
  6. Listed and labeled outdoor appliance connectors in compliance with ANSI Z21.75/CSA 6.27 and installed in accordance with the manufacturer's installation instructions.
- 434) G2422.1.1. Connectors and tubing shall be installed so as to be protected against physical damage.
- 435) G2422.1.2. Appliance fuel connectors shall be installed in accordance with the manufacturer's instructions and Sections G2422.1.2.1 through G2422.1.2.4.

- 436) G2422.1.2.1. Connectors shall not exceed 6 feet in overall length. Measurement shall be made along the centerline of the connector. Only one connector shall be used for each appliance.  
**Exception:** Rigid metallic piping used to connect an appliance to the piping system shall be permitted to have a total length greater than 6 feet provided that the connecting pipe is sized as part of the piping system in accordance with Section G2413 and the location of the appliance shutoff valve complies with Section G2420.5.
- 437) G2422.1.2.3. Connectors shall not be concealed within, or extended through, walls, floors, partitions, ceilings or appliance housings.  
**Exceptions:**  
1. Connectors constructed of materials allowed for piping systems in accordance with Section G2414 shall be permitted to pass through walls, floors, partitions and ceilings where installed in accordance with Section G2420.5.2 or G2420.5.3.  
2. Rigid steel pipe connectors shall be permitted to extend through openings in appliance housings.  
3. Fireplace inserts that are factory equipped with grommets, sleeves or other means of protection in accordance with the listing of the appliance.  
4. Semirigid tubing and listed connectors shall be permitted to extend through an opening in an appliance housing, cabinet or casing where the tubing or connector is protected against damage.
- 438) G2422.1.4. A union fitting shall be provided for appliances connected by rigid metallic pipe. Such unions shall be accessible and located within 6 feet of the appliance.
- 439) G2422.1.5. Where appliances are equipped with casters or are otherwise subject to periodic movement or relocation for purposes such as routine cleaning and maintenance, such appliances shall be connected to the supply system piping by means of an approved flexible connector designed and labeled for the application. Such flexible connectors shall be installed and protected against physical damage in accordance with the manufacturer's installation instructions.
- 440) G2439.1. Clothes dryers shall be exhausted in accordance with the manufacturer's instructions. Dryer exhaust systems shall be independent of all other systems and shall convey the moisture and any products of combustion to the outside of the building.
- 441) G2439.2. Ducts that exhaust clothes dryers shall not penetrate or be located within any fireblocking, draftstopping or any wall, floor/ceiling or other assembly required by this code to be fire-resistance rated, unless such duct is constructed of galvanized steel or aluminum of the thickness specified in the mechanical provisions of this code and the fire-resistance rating is maintained in accordance with this code. Fire dampers shall not be installed in clothes dryer exhaust duct systems.
- 442) G2439.3. Dryer exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums.
- 443) G2439.4. Installations exhausting more than 200 cfm shall be provided with makeup air. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches for makeup air shall be provided in the closet enclosure, or makeup air shall be provided by other approved means.
- 444) G2439.5.1. Exhaust ducts shall have a smooth interior finish and shall be constructed of metal a minimum 0.016-inch thick. The exhaust duct size shall be 4 inches nominal in diameter.
- 445) G2439.5.2. Exhaust ducts shall be supported at 4 foot intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude into the inside of the duct.

- 446) G2439.5.3. Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than 1<sup>1</sup>/<sub>4</sub> inches between the duct and the finished face of the framing member. Protective shield plates shall be constructed of steel, shall have a minimum thickness of 0.062 inch and shall extend a minimum of 2 inches above sole plates and below top plates.
- 447) G2439.5.4. Transition ducts used to connect the dryer to the exhaust duct system shall be a single length that is listed and labeled in accordance with UL 2158A. Transition ducts shall be a maximum of 8 feet in length and shall not be concealed within construction.
- 448) G2439.5.5.1. The maximum length of the exhaust duct shall be 35 feet from the connection to the transition duct from the dryer to the outlet terminal. Where fittings are used, the maximum length of the exhaust duct shall be reduced in accordance with Table G2439.5.5.1.
- 449) G2439.5.5.2. The maximum length of the exhaust duct shall be determined by the dryer manufacturer's installation instructions. The code official (Inspector) shall be provided with a copy of the installation instructions for the make and model of the dryer. Where the exhaust duct is to be concealed, the installation instructions shall be provided to the code official prior to the concealment inspection. In the absence of fitting equivalent length calculations from the clothes dryer manufacturer, Table G2439.5.5.1 shall be used.
- 450) G2439.5.6. Where the exhaust duct is concealed within the building construction, the equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet of the exhaust duct connection.
- 451) G2439.5.7. Where space for a clothes dryer is provided, an exhaust duct system shall be installed. Where the clothes dryer is not installed at the time of occupancy, the exhaust duct shall be capped at location of the future dryer.  
**Exception:** Where a listed condensing clothes dryer is installed prior to occupancy of the structure.
- 452) G2445.2. One or more unvented room heaters shall not be used as the sole source of comfort heating in a dwelling unit.
- 453) G2445.7. An unvented decorative room heater shall not be installed in a factory-built fireplace unless the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.

#### RADON

- 454) AF103.2. A layer of gas-permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces of the building, to facilitate future installation of a sub-slab depressurization system, if needed. The gas-permeable layer shall consist of one of the following:
1. A uniform layer of clean aggregate, a minimum of 4 inches thick. The aggregate shall consist of material that will pass through a 2-inch sieve and be retained by a 1<sup>1</sup>/<sub>4</sub>-inch sieve.
  2. A uniform layer of sand (native or fill), a minimum of 4 inches thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.
  3. Other materials, systems or floor designs with demonstrated capability to permit depressurization across the entire sub-floor area.
- 455) AF103.3. A minimum 6-mil or [3-mil cross-laminated] polyethylene or equivalent flexible sheeting material shall be placed on top of the gas-permeable layer prior to casting the slab or placing the floor assembly to serve as a soil-gas-retarder by bridging any cracks that develop in the slab or floor assembly and to prevent concrete from entering the void spaces in the aggregate base material. The sheeting shall cover the entire floor area with separate sections of sheeting lapped at least 12 inches. The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All punctures or tears in the material shall be sealed or covered with additional sheeting.

- 456) AF103.4. Potential radon entry routes shall be closed in accordance with Sections AF103.4.1 through AF103.4.10.
- 457) AF103.4.1. Openings around bathtubs, showers, water closets, pipes, wires or other objects that penetrate concrete slabs or other floor assemblies shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.
- 458) AF103.4.2. All control joints, isolation joints, construction joints and any other joints in concrete slabs or between slabs and foundation walls shall be sealed with a caulk or sealant. Gaps and joints shall be cleared of loose material and filled with polyurethane caulk or other elastomeric sealant applied in accordance with the manufacturer's recommendations.
- 459) AF103.4.3. Condensate drains shall be trapped or routed through nonperforated pipe to daylight.
- 460) AF103.4.4. Sump pits open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid. Sumps used as the suction point in a sub-slab depressurization system shall have a lid designed to accommodate the vent pipe. Sumps used as a floor drain shall have a lid equipped with a trapped inlet.
- 461) AF103.4.5. Hollow block masonry foundation walls shall be constructed with either a continuous course of solid masonry, one course of masonry grouted solid, or a solid concrete beam at or above finished ground surface to prevent passage of air from the interior of the wall into the living space. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall be sealed. Joints, cracks or other openings around all penetrations of both exterior and interior surfaces of masonry block or wood foundation walls below the ground surface shall be filled with polyurethane caulk or equivalent sealant. Penetrations of concrete walls shall be filled.
- 462) AF103.4.7. Air-handling units in crawl spaces shall be sealed to prevent air from being drawn into the unit.  
**Exception:** Units with gasketed seams or units that are otherwise sealed by the manufacturer to prevent leakage.
- 463) AF103.4.8. Ductwork passing through or beneath a slab shall be of seamless material unless the air-handling system is designed to maintain continuous positive pressure within such ducting. Joints in such ductwork shall be sealed to prevent air leakage. Ductwork located in crawl spaces shall have all seams and joints sealed by closure systems in accordance with Section M1601.4.1.
- 464) AF103.4.9. Openings around all penetrations through floors above crawl spaces shall be caulked or otherwise filled to prevent air leakage.
- 465) AF103.4.10. Access doors and other openings or penetrations between basements and adjoining crawl spaces shall be closed, gasketed or otherwise filled to prevent air leakage.
- 466) AF103.5. In buildings with crawl space foundations, the following components of a passive sub-membrane depressurization system shall be installed during construction.  
**Exception:** Buildings in which an approved mechanical crawl space ventilation system or other equivalent system is installed.
- 467) AF103.5.1. Crawl spaces shall be provided with vents to the exterior of the building. The minimum net area of ventilation openings shall comply with Section R408.1 of this code.
- 468) AF103.5.2. The soil in crawl spaces shall be covered with a continuous layer of minimum 6-mil polyethylene soil-gas-retarder. The ground cover shall be lapped a minimum of 12 inches at joints and shall extend to all foundation walls enclosing the crawl space area.
- 469) AF103.5.3. A plumbing tee or other approved connection shall be inserted horizontally beneath the sheeting and connected to a 3- or 4-inch-diameter fitting with a vertical vent pipe installed through the sheeting. The vent pipe

shall be extended up through the building floors, terminate at least 12 inches above the roof in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any window or other opening in adjoining or adjacent buildings.

- 470) AF103.6. In basement or slab-on-grade buildings, the following components of a passive sub-slab depressurization system shall be installed during construction.
- 471) AF103.6.1. A minimum 3-inch-diameter ABS, PVC or equivalent gas-tight pipe shall be embedded vertically into the sub-slab aggregate or other permeable material before the slab is cast. A "T" fitting or equivalent method shall be used to ensure that the pipe opening remains within the sub-slab permeable material. Alternatively, the 3-inch pipe shall be inserted directly into an interior perimeter drain tile loop or through a sealed sump cover where the sump is exposed to the sub-slab aggregate or connected to it through a drainage system. The pipe shall be extended up through the building floors, terminate at least 12 inches above the surface of the roof in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any window or other opening in adjoining or adjacent buildings.
- 472) AF103.6.2. In buildings where interior footings or other barriers separate the sub-slab aggregate or other gas-permeable material, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.
- 473) AF103.7. All components of the radon vent pipe system shall be installed to provide positive drainage to the ground beneath the slab or soil-gas-retarder.
- 474) AF103.8. Radon vent pipes shall be accessible for future fan installation through an attic or other area outside the habitable space.  
**Exception:** The radon vent pipe need not be accessible in an attic space where an approved roof-top electrical supply is provided for future use.
- 475) AF103.9. All exposed and visible interior radon vent pipes shall be identified with at least one label on each floor and in accessible attics. The label shall read: "Radon Reduction System."
- 476) AF103.10. Combination basement/crawl space or slab-on-grade/crawl space foundations shall have separate radon vent pipes installed in each type of foundation area. Each radon vent pipe shall terminate above the roof or shall be connected to a single vent that terminates above the roof.
- 477) AF103.11. Joints in air ducts and plenums in unconditioned spaces shall meet the requirements of Section M1601. Thermal envelope air infiltration requirements shall comply with the energy conservation provisions in 2009 IECC. Firestopping shall meet the requirements contained in Section R602.8.
- 478) AF103.12. To provide for future installation of an active sub-membrane or sub-slab depressurization system, an electrical circuit terminated in an approved box shall be installed during construction in the attic or other anticipated location of vent pipe fans. An electrical supply shall also be accessible in anticipated locations of system failure alarms.
- 479) AG105.2. An outdoor swimming pool, including an in-ground, above-ground or on-ground pool, hot tub or spa shall be surrounded by a barrier which shall comply with the following:
1. The top of the barrier shall be at least 60 inches above grade measured on the side of the barrier which faces away from the swimming pool. The maximum vertical clearance between grade and the bottom of the barrier shall be 2 inches measured on the side of the barrier which faces away from the swimming pool. Where the top of the pool structure is above grade, such as an above-ground pool, the barrier may be at ground level, such as the pool structure, or mounted on top of the pool structure. Where the barrier is mounted on top of the pool structure, the maximum vertical clearance between the top of the pool structure and the bottom of the barrier shall be 4 inches.
  2. Openings in the barrier shall not allow passage of a 4-inch-diameter sphere.
  3. Solid barriers which do not have openings, such as a masonry or stone wall, shall not contain indentations or protrusions except for normal construction tolerances and tooled masonry joints.

4. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 45 inches, the horizontal members shall be located on the swimming pool side of the fence. Spacing between vertical members shall not exceed  $1\frac{3}{4}$  inches in width. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed  $1\frac{3}{4}$  inches in width.
5. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is 45 inches or more, spacing between vertical members shall not exceed 4 inches. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed  $1\frac{3}{4}$  inches in width.
6. Maximum mesh size for chain link fences shall be a  $2\frac{1}{4}$ -inch square unless the fence has slats fastened at the top or the bottom which reduce the openings to not more than  $1\frac{3}{4}$  inches.
7. Where the barrier is composed of diagonal members, such as a lattice fence, the maximum opening formed by the diagonal members shall not be more than  $1\frac{3}{4}$  inches.
8. Access gates shall comply with the requirements of Section AG105.2, Items 1 through 7, and shall be equipped to accommodate a locking device. Pedestrian access gates shall open outward away from the pool and shall be self-closing and have a self-latching device. Gates other than pedestrian access gates shall have a self-latching device. Where the release mechanism of the self-latching device is located less than 54 inches from the bottom of the gate, the release mechanism and openings shall comply with the following:
  - 8.1. The release mechanism shall be located on the pool side of the gate at least 3 inches below the top of the gate; and
  - 8.2. The gate and barrier shall have no opening larger than  $\frac{1}{2}$  inch within 18 inches of the release mechanism.
9. Where a wall of a dwelling serves as part of the barrier, one of the following conditions shall be met:
  - 9.1. The pool shall be equipped with a powered safety cover in compliance with ASTM F 1346; or
  - 9.2. Doors with direct access to the pool through that wall shall be equipped with an alarm which produces an audible warning when the door and/or its screen, if present, are opened. The alarm shall be listed and labeled in accordance with UL 2017. The deactivation switch(es) shall be located at least 54 inches above the threshold of the door; or
10. Where an above-ground pool structure is used as a barrier or where the barrier is mounted on top of the pool structure, and the means of access is a ladder or steps:
  - 10.1. The ladder or steps shall be capable of being secured, locked or removed to prevent access; or
  - 10.2. The ladder or steps shall be surrounded by a barrier which meets the requirements of Section AG105.2, Items 1 through 9. When the ladder or steps are secured, locked or removed, any opening created shall not allow the passage of a 4-inch-diameter sphere.

- 480) AG105.3. Walls surrounding an indoor swimming pool shall comply with Section AG105.2, Item 9.
- 481) AG105.4. Barriers shall be located to prohibit permanent structures, equipment or similar objects from being used to climb them.
- 482) AG105.5. Spas or hot tubs with a safety cover which complies with ASTM F 1346, as listed in Section AG107, shall be exempt from the provisions of this appendix.

**The following is taken from the 2009 IECC (Energy Conservation Code)**

- 483) 401.3. A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominant R-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor) and ducts outside conditioned spaces and U-factors for fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be listed for gas-fired unvented room heaters, electric furnaces or electric baseboard heaters.

- 484) 402.2.3. Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.
- 485) 402.2.6. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.
- 486) 402.2.7. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections 402.1.1 and 402.2.6.
- 487) 402.2.8. Slab-on-grade floors with a floor surface less than 12 inches below grade shall be insulated in accordance with Table 402.1.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table 402.1.1 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall.
- 488) 402.2.9. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches. Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder. All joints of the vapor retarder shall overlap by 6 inches and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached to the stem wall.
- 489) 402.4.1. The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:
1. All joints, seams and penetrations.
  2. Site-built windows, doors and skylights.
  3. Openings between window and door assemblies and their respective jambs and framing.
  4. Utility penetrations.
  5. Dropped ceilings or chases adjacent to the thermal envelope.
  6. Knee walls.
  7. Walls and ceilings separating a garage from conditioned spaces.
  8. Behind tubs and showers on exterior walls.
  9. Common walls between dwelling units.
  10. Attic access openings.
  11. Rim joist junction.
  12. Other sources of infiltration.
- 490) 402.4.3. New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.
- 491) 402.4.5. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm of air movement from the conditioned space to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.



- 492) 403.1. At least one thermostat shall be provided for each separate heating and cooling system.
- 493) 403.1.1. Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F or up to 85°F. The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F and a cooling temperature set point no lower than 78°F.
- 494) 403.2.2. All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.4.1 of the International Residential Code.  
Duct tightness shall be verified by either of the following:  
1. Postconstruction test: Leakage to outdoors shall be less than or equal to 8 cfm per 100 ft<sup>2</sup> of conditioned floor area or a total leakage less than or equal to 12 cfm per 100 ft<sup>2</sup> of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.  
2. Rough-in test: Total leakage shall be less than or equal to 6 cfm per 100 ft<sup>2</sup> of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm per 100 ft<sup>2</sup> of conditioned floor area.  
**Exception:** Duct tightness test is not required if the air handler and all ducts are located within conditioned space.
- 495) 403.2.3. Building framing cavities shall not be used as supply ducts.
- 496) 403.3. Mechanical system piping capable of carrying fluids above 105°F or below 55°F shall be insulated to a minimum of R-3.
- 497) 403.4. All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot- water circulating pump when the system is not in use.
- 498) 403.5. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.
- 499) 403.6. Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the International Residential Code.
- 500) 403.7. Systems serving multiple dwelling units shall comply with Sections 503 and 504 in lieu of Section 403.
- 501) 403.8. Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F, and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F.
- 502) 403.9.1. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.
- 503) 403.9.2. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.  
**Exceptions:**  
1. Where public health standards require 24-hour pump operation.  
2. Where pumps are required to operate solar- and waste-heat-recovery pool heating systems.
- 403.9.3 Pool covers. Heated pools shall be equipped with a vapor-retardant pool cover on or at the water surface. Pools heated to more than 90°F shall have a pool cover with a minimum insulation value of R-12.

**Exception:** Pools deriving over 60 percent of the energy for heating from site-recovered energy or solar energy source.

**The following has been added to the IRC by Executive Regulation: Chapter 45, Site Work and Safeguards.**

- R4501. Construction equipment and materials shall be stored and placed so as not to endanger the public, the workers or adjoining property for the duration of the construction project. Construction debris and/or materials shall be stored and disposed in a suitable manner so as not to endanger the public and not spread onto the lot and adjoining properties.
- R4502. Service utility connections shall be disconnected and capped in accordance with the approved rules and the requirements of the authority having jurisdiction.
- R4503. Excavation and fill for buildings and structures shall be constructed or protected so as not to endanger life or property.
- R4504. A building permit is required when fill is used to support the foundation of any building or structure. Special inspections of compacted fill shall be in accordance with Section 1704.7 of the International Building Code 2009.
- R4505.1. Pedestrians shall be protected during construction, remodeling and demolition activities by a barrier when the distance from the construction to the lot line is 5 feet or less.
- R4505.2. Every excavation on a site located 5 feet or less from the street lot line shall be enclosed with a barrier. Where located more than 5 feet from the street lot line, a barrier shall be erected when and where required by the building official.
- R4505.3. Barriers shall be at least 42" high, have adequate strength, and shall be of a type which will warn of potential danger.
- R4506. Adjoining public and private property shall be protected from damage during construction, remodeling and demolition work. Protection shall be provided for footings, foundations, party walls, chimneys, skylights and roofs.